JUNE 1956

# Power Engineering


How Subsoil Conditions Affect Your Power Plant Foundation 65
This Back-Pressure Turbine Pays Off for Norton 67
Can Air-Operated Ejectors Solve Your Problem? 69
Supercharged Boilers—Next Step? 72
Paper Mill and Utility Interconnections Raise and Solve Problems—I 76
Loose-Jointed Probe Takes Selective Coal Samples 79
Economical Fuel Oil Treatment Extends Use of Gas Turbine 80
Thermonuclear Power—Man's Most Glittering Dream 82
Boiler Heat Balance . . . . Heat Losses Due to Radiation 86
Burlington's New Unit No. 7 Averages 9,000 Btu per kwh 88
How Detroit Edison Trains Operators for Their New Stations 90
Graphite-Impregnated Plastic Solves Precipitator Problem 93
Safety and Time-Saving Ideas for Turbine Generator Overhaul 94
Handling Temperature Variations in Control Systems 96
New Hand-Powered Fasteners Get Powerful Drive 98


## REGULAR DEPARTMENTS


Engineers' Preview ..... 3
What They Tell Us ..... 6
Helpful Bulletins ..... 25
Construction News ..... 44
Equipment News ..... 46
News Reel ..... 74
Power Engineering Handbook ..... 96
New Engineering Books ..... 114
Catalog Library ..... 123
Reader Service Post Cards ..... 123
Advertisers' Index ..... 138
Circulation of This Issue ..... 38,680

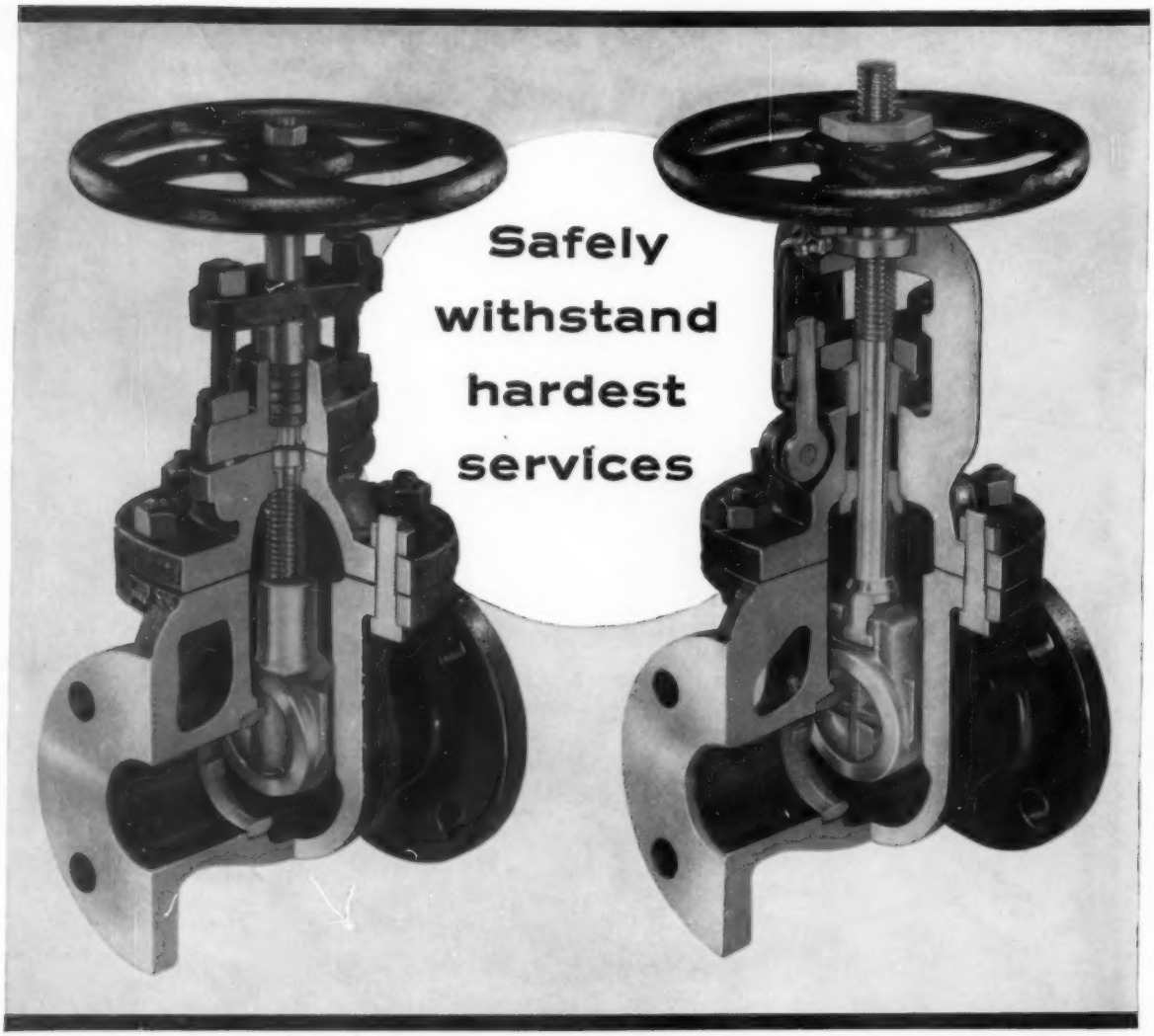



Fig. 1138 (left) non-rising stem, Fig. 1140 (right) OS&Y... two of 29 OIC iron valves with steel valve features. Metals used for trim and pressure parts in this line include: bronze, manganese bronze, nickel-plated steel, higher strength iron, nickel-alloyed iron, Monel, 18-8 stainless, 11-½-13 chrome.

Reduce valve wear. Choose from 29 OIC iron valve numbers with 9 different trim and body metal variations. Depend on them for general use and process industry services handling alkaline liquors, creosote, sour crude, sulphuric acid and caustics.

**Working parts design assures positive seating . . . long life**

Seat rings are end seated, reducing the probability of loosening in service and affording streamlined flow from port to port. Body wedge guides and a flexible T-head stem-wedge connection combine to assure accurate wedge seating for tight shutoff.

**Extra strength adds safety to pressure parts**

High-strength iron castings assure pressure parts made to a minimum tensile strength of 31,000 psi. The body and bonnet, elliptical in shape, resist internal pressure with least possible distortion. Body-bonnet bolting provides uniform gasket loading and, consequently, a pressure-tight seal throughout the pressure range of the valves. Tie ribs, cast between the pipeline flange and the body bonnet flange, prevent distortion from excessive pipeline stresses.

This line's many added features, trim variations, dimensions and end openings are completely described in the new OIC specification folder, Form No. 1005. Write for it.

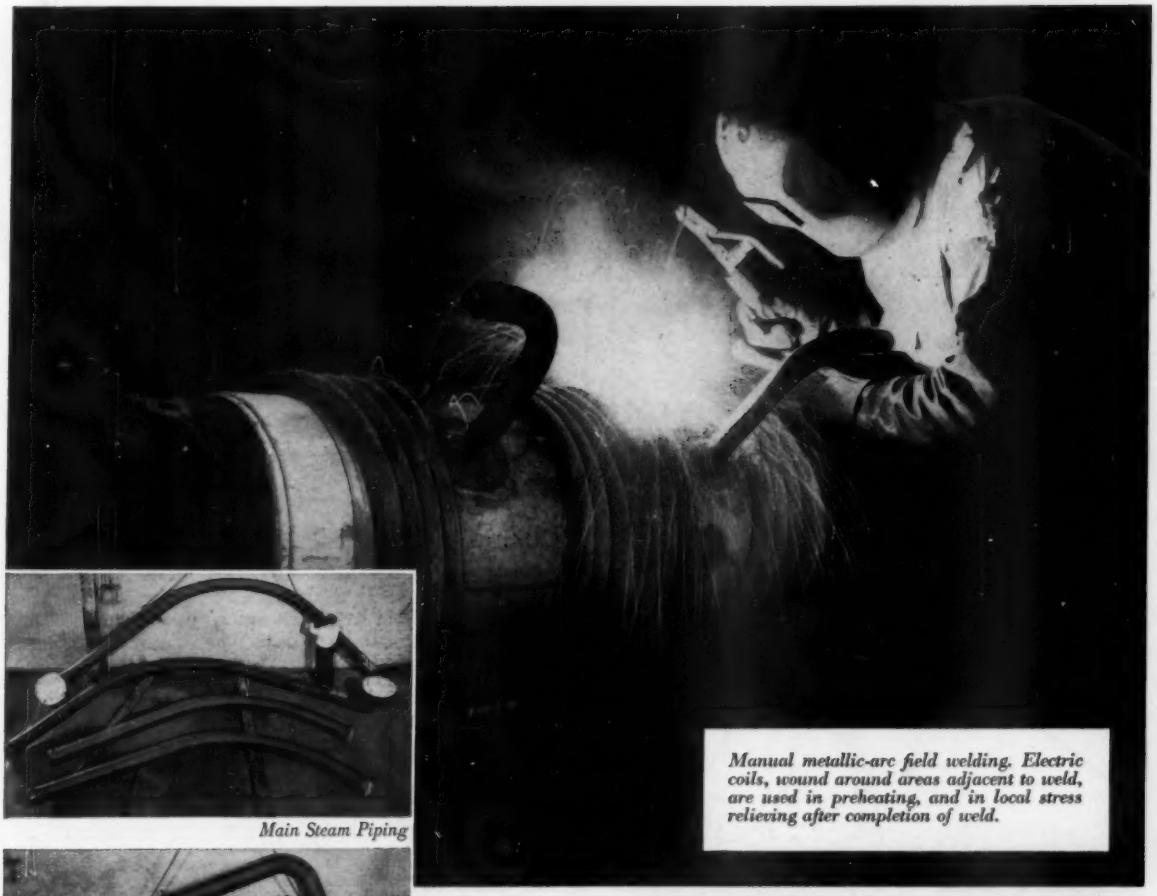
***Order valves from your OIC Distributor.***

OIC
FOUNDED 1883

**THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO**

**VALVES** | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES**

For more data circle 501 on Post Card

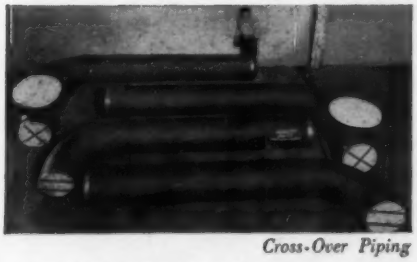


*Manual metallic-arc field welding. Electric coils, wound around areas adjacent to weld, are used in preheating, and in local stress relieving after completion of weld.*



*Main Steam Piping*

*Hot Reheat Piping*



*Cross-Over Piping*

*Shop fabricated assemblies above are produced to sizes which installation and shipping facilities permit.*

# FIELD ERECTION by P.P.&E.

## Assures Safe, Efficient Operation of HIGH TEMPERATURE, HIGH PRESSURE PIPING

Pittsburgh Piping and Equipment Company was among the first to recognize the importance of complete piping fabricating service, including the responsibility for erection of the piping system.

At P.P.&E. sub-assembles are shop fabricated in sections as large as shipping facilities and installation area permits, are checked for dimensional alignment, and delivered ready for accurate erection. Field welds are planned for maximum accessibility. Consequently, erection by skilled, specially trained craftsmen is facilitated.

An experienced P.P.&E. field organization handles all erection problems, and coordinates field work with shop fabrication so that materials arrive on schedule, and in the sequence which permits erection to proceed rapidly and efficiently.

**PRODUCTS AND SERVICES**

| | |
|---|---|
| Carbon Steel Piping | Forged Piping Materials |
| Cast Iron Fittings | Headers |
| Cast Steel Fittings | Manifolds |
| Chrome-Moly Piping | Pipe Bends |
| Copper Piping | Stainless Steel Piping |
| Corrugated Piping | Van Stoning |
| Creased Bends | Welded Assemblies |
| Expansion Bends | Welded Stainless Steel Tubing |
| Flanges | welding Fittings |

PP-15

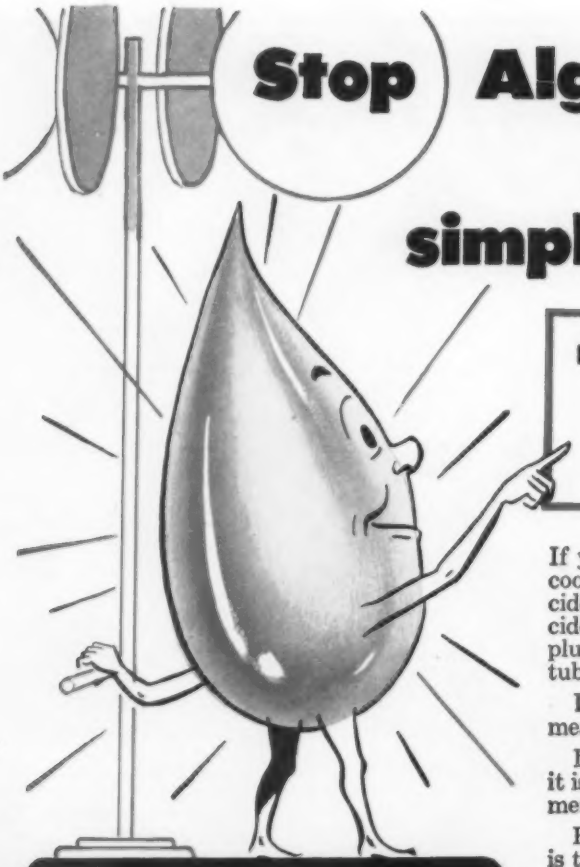
Pittsburgh Piping
AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

**OFFICES IN PRINCIPAL CITIES**

| | |
|---|---|
| Atlanta | Whitehead Building |
| Boston | 10 High Street |
| Chicago | Peoples Gas Building |
| Cleveland | Public Square Building |
| Houston | Heights State Bank Building |
| Los Angeles | 1830 North Alexandria Ave. |
| New Orleans | P. O. Box 74 |
| New York | Woolworth Building |
| Syracuse | 113 Sh. Salina Street |
| Toronto | 60 Yonge Street |
| Washington | Wire Building |

For more data circle 502 on Post Card

# Stop Algae Problems *NEW* simple, low-cost way



**NEW Allis-Chalmers Algaecide kills all classes of algae and other microscopic organisms in cooling water**

If you are troubled by slimes and algae in your cooling tower system, new No. 120 Series Algaecide is the answer. It is the most effective algaecide known. It eliminates such problems as plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers.

It is easy to introduce into the system by means of a pump, drip feed or manual feed.

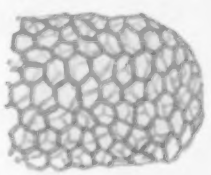
It is safe to handle. Even in concentrated form it is only a mild irritant to skin, eyes and mucous membranes.

Field tests prove that a 5-ppm concentration is toxic to most organisms.

Get complete information on No. 120 Series Algaecide. Call your nearest A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

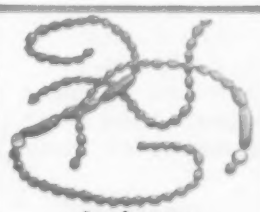
Call on
**ALLIS-CHALMERS**
for
**Water Conditioning**

**As little as 2 ppm has killed all these algae**



**Hydrodictyon**

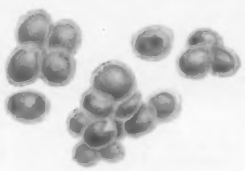
**Microcystis**



**Anabaena**

**Oocystis**

**Chlorella**



**Protococcus**

# ALLIS-CHALMERS

A-5071

For more data circle 503 on Post Card

## EDITORIAL AND BUSINESS STAFF

POWER ENGINEERING IS PUBLISHED MONTHLY
110 S. DEARBORN ST., CHICAGO 3, ILL.
DEARBORN 2-5446

**EDITORIAL AND ART STAFF**

| | |
|---|---|
| Editorial Director | Richard H. Morris |
| Editor | Andrew W. Kramer |
| Executive Editor | Chester R. Earle |
| Associate Editor | Norman S. Jones |
| Associate Editor | R. C. Hagenmiller |
| Equipment Editor | Marian E. Heniken |
| Assistant Editor | Irene M. Glen |
| Editorial Assistant | Mildred Novosel |
| Staff Artist | James E. Wilcox |
| Chief Draftsman | Robert W. Koster |

**OFFICERS AND BUSINESS STAFF**

| | |
|---|---|
| President | Kingsley L. Rice |
| Executive Vice President | Edwin C. Prouty |
| Treasurer | Arthur L. Rice., Jr. |
| Assistant Treasurer | Thomas Walsh |
| Secretary | Edwin C. Prouty, Jr. |
| Production Director | John O. Aarvold |
| Production Manager | Earl R. Noren |

**DISTRICT MANAGERS**

| | |
|---|---|
| New England<br>5 Spring St., Riverside, Conn. | Charles R. Lippold<br>NEptune 7-2210 |
| New York 17, N. Y.<br>1613 Graybar Bldg. | Joseph Halloran<br>MUrray Hills 5-3779 |
| Philadelphia, Pa.<br>1235 Jericho Road (Abington, Pa.) | Oscar Wilds<br>TUmer 7-6688 |

**WESTERN SALES MANAGER**

John R. Morrison

| | |
|---|---|
| Pittsburgh 19, Pa.<br>404 Frick Bldg. | James B. Tafel<br>COurt 1-4878 |
| Central District<br>321 Maple-Lake Lucerne<br>Chagrin Falls, Ohio | Edmund M. Ingersoll<br>Kingswood 3-4821<br>(Call collect) |
| Chicago 3, Ill.<br>110 S. Dearborn St. | John R. Morrison, Warren F. Saas<br>DEarborn 2-5446 |
| Seattle 4, Wash.<br>1008 Western Ave. | Harry Abney<br>ELliott 3767 |
| San Francisco 5, Calif.<br>615 Market St. | Les Meek<br>YUkon 60-647 |
| Los Angeles 5, Calif.<br>3727 West Sixth Street | Connie J. Grabb<br>DUnkirk 7-5391 |
| Denver 2, Colo.<br>222 Colo. National Bank Bldg. | Robert Heidersbach<br>KEystone 4-4669 |
| Houston 6, Texas<br>Room 214, 3214 Montrose Blvd. | Frank Vickery<br>JAckson 9-6711 |
| Dallas 6, Texas<br>5526 Dyer St. | Ed. J. Whetzle<br>FOrest 8-5510 |
| Tulsa, Okla.<br>2010 South Utica | Ted R. Trautman<br>Riverside 3-1981 |

Change of Address: Send to POWER ENGINEERING, Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Request must reach us by 15th of month to make the change, effective with the following month's issue.

Subscription Information: Published monthly price in the United States and its possessions $10, in Canada $11, other countries $12 per year; single copies $1.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

Microfilm edition: Request prices from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948



Copyright 1956 by Technical Publishing Co., Chicago, Illinois. Accepted as controlled circulation publication at Concord, New Hampshire.



NBP BPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS


# ENGINEERS' PREVIEW

**PLANS are taking shape rapidly for the big Northwest Power Show to be held June 28 to July 1 in the Minneapolis Municipal Auditorium in conjunction with the annual convention of the American Chief Engineers Association. Full details may be obtained from Trade Shows, Inc., 1437 Northwestern Bank Bldg., Minneapolis, which will manage all details of the Show.**

CONDUCTOR REACTANCE CHART — Correction Note: In the article entitled Conductor Reactance Chart, page 67, April 1956 issue, we showed a quick and convenient method of finding conductor reactances. A worked example gave a line reactance of 0.038 ohms per 1000 ft, but owing to a typographical error this figure appeared in the text as 0.38 ohms per 1000 ft. Also the expression for equivalent spacings in Fig. 2 should read $\sqrt[3]{A \times B \times C}$ and *not* $\sqrt[3]{A + B + C}$

**NEW PIPE MARKING Standard Adopted — American Society of Mechanical Engineers has announced publication of the revised *American Standard Scheme for the Identification of Piping Systems (ASA A13.1-1956).* Use of this standard for marking pipes in power plants and industrial installations is strongly recommended to promote safety and lessen the chance of confusion in emergencies — particularly when such outside agencies as fire departments are likely to become involved. Copies may be obtained from the ASME Order Dept., 29 West 39th St., New York 18, N. Y., at $1.00 each.**

THREE TYPES of controls that may be coupled together to provide complex information quickly and accurately are the mass spectrometer, the digitalizer and the digital computer, Dr. John J. Grebe of Dow Chemical Co. told the National Technical Conference on New Developments in Instrumentation for Industrial Control, sponsored by AIEE.

Consider the possibilities of such a team. In 15 min. the mass spectrometer can analyze a complex organic mixture for as many as 30 or more components. The "digitizer" records data as fast as the mass spec evolves them. A small to medium-sized computer can calculate the data in one or two minutes. Dr. Grebe said that the greatest source of specific new technology for measurement and control has to do with radioactive isotopes.

REPUBLIC FLOW METERS CO., Chicago, was praised and honored at a special ceremony at the plant for compiling an outstanding safety record — one full year without a single lost-time accident. James D. Cunningham, president of the company, was presented a citation of award and a plaque from Lumbermen's Mutual Casualty Co. by Joseph E. Magnus, chairman of the Chicago agency of James S. Kemper & Co., at the ceremony attended by more than 350 Republic Flow Meters employees.

## POWER ENGINEERING Wins NSC Award Again

**FOR THE SECOND YEAR in succession, POWER ENGINEERING has been honored by the National Safety Council with a Public Interest Award, this one for 1955. This award is made annually to various types of publications for exceptional service to safety. In the case of POWER ENGINEERING, this service consisted of the articles published during 1955 on phases of power plant safety.**

**The Editors of POWER ENGINEERING are much gratified that they have been able to present articles of value to power engineers on a subject that the latter never can lose sight of for an instant. POWER ENGINEERING is the only magazine in the strictly power engineering field to win the NSC award for both 1954 and 1955. Our companion magazine, *Plant Engineering*, also received the NSC safety award for 1955 in its separate field, as it has done regularly for several years.**

**PRESIDENT EISENHOWER** has accepted honorary membership in The American Society of Mechanical Engineers, highest honor awarded by the 41,000-member organization. He became the first President of the United States to be so honored while in office. Former President Herbert C. Hoover was named to honorary membership in 1925, three years before he was elected to the presidency.

COMMONWEALTH EDISON has placed an order for another big 305,000-kw turbine generator. The unit, which will be built by Allis-Chalmers Manufacturing Co., is the second of this size recently ordered by Commonwealth. The other was ordered from General Electric Co.

The 305,000-kw machines are larger than any now in operation in the country, although several others of comparable size have been ordered by other large utility systems. The new unit will be installed at Fisk Station in Chicago.

**NEW SLIDEFILM** instruction course designed to aid in the training of industrial personnel in the selection and application of modern and electronic control equipment has been made available by the General Electric Co. Designed for the indoctrination of both technical and non-technical personnel the course is composed of eight 35mm color sidefilms and recordings which treat virtually every common aspect of control. It also includes an instructor's manual and eight review booklets. The course is available on a single loan or sale basis. If you're interested in more information about this course, write the *Engineers' Preview* editor.

**MAKE-IT-YOURSELF**
**Transmission Line Calculator**

**Hundreds of readers have already requested the full-size cut-outs and instructions for making this calculator, as described on page 106, March 1956 issue.**

**However, we still have a supply of the cut-outs and if you want a set, write the Editor, POWER ENGINEERING or jot Transmission Line Calculator on one of the prepaid post cards elsewhere in this issue and mail it to us.**

# POWER ENGINEERING Editors Attend European Engineering Meetings

TWO MEMBERS of the POWER ENGINEERING editorial staff are now in Europe to attend important international engineering meetings being held there throughout the summer. They will also visit important industrial and utility power plants all over Europe, will go into Russia for a 30-day trip and will report their observations in dispatches to POWER ENGINEERING.

Richard H. Morris, editorial director of POWER ENGINEERING, flew to Glasgow, Scotland on May 4, and after visiting industrial plants in Scotland, flew to Berlin to attend the 100th anniversary celebration of the German Engineering Society (Verein Deutsche Ingenieure, known as VDI). Following that meeting he returned to England to attend the annual meeting of the Incorporated Plant Engineers at Harrogate and afterwards visited more industrial plants in England.

On May 26 he was joined in London by A. W. Kramer, editor of POWER ENGINEERING. The two men were scheduled to attend the annual meeting in Paris, May 30 through June 9, of the International Conference on Large High Tension Electric Systems (Conference International des Grands Resaux Electriques, known as CIGRE).

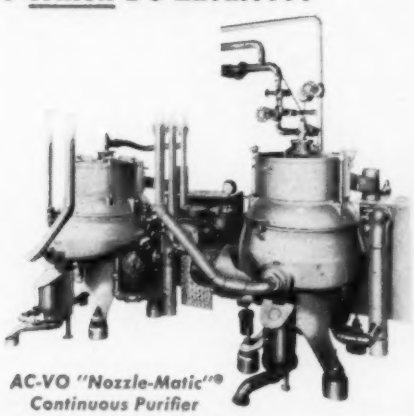
Following this, the two editors will go into Switzerland to visit Swiss manufacturers of power equipment, thence to Vienna, Austria for the week-long World Power Conference. After the conference tour of industrial plants in Austria, Yugoslavia and Italy, they are to join a party of members of the Society of Business Magazine Editors (Morris is 1956 president of SBME) for an official 30-day trip through Russia, visiting important power and industrial plants.

Fig. 1. A. W. Kramer, editor of POWER ENGINEERING magazine, leaving Chicago to begin European Conference trip

Fig. 2. R. H. Morris (right) editorial director of POWER ENGINEERING, "bon voyaged" as he boarded plane to Europe

# NOW...

## Diesel Operation on Heavy Fuel Is Simply a Question of Which De Laval!...



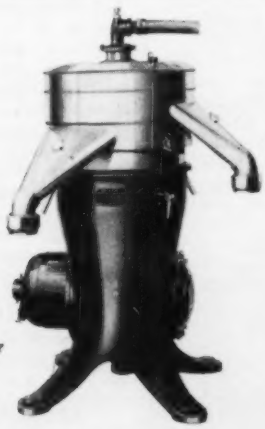
*AC-VO "Nozzle-Matic"® Continuous Purifier*

There is no longer any doubt as to both the *economy* and the *practicality* of burning residual fuels in diesel engines.

And, today, there is also no question of getting the *precise* centrifugal purifier to prepare heavy fuel for any particular set of circumstances . . . *De Laval* provides three different types. Each type has proved its efficiency and freedom from trouble in many installations, both land and marine.

Recommended capacities of each type are given below. Complete details on request . . . without obligation!

*PX 209.00 Self-cleaning Centrifuge*



*Standard Purifier*

## RECOMMENDED CAPACITIES — G.P.H.

| VIS. | TEMP. | AC-VO | PX 209. F | STANDARD PURIFIER |
|---|---|---|---|---|
| 500 | 180° F | 1200 | 600 | 300 |
| 700 | 180° F | 1100 | 550 | 275 |
| 1700 | 180° F | 660 | 330 | 165 |
| 2500 | 180° F | 560 | 280 | 140 |
| 4000 | 190° F | 440 | 220 | 110 |
| 5000 | 200° F | 300 | 150 | 75 |

**DE LAVAL**
*heavy fuel oil purifiers*

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.

For more data circle 504 on Post Card

# WHAT THEY TELL US

**THAT FLY-ASH BUG** has grown into a pigeon, Bert Richards tells us, in the following:

> Conning over some back numbers of POWER ENGINEERING my eagle orb lighted on one article published in '54 regarding fly ash disposal. Apparently for many years this stuff had only nuisance value, no practical use known for it as an industrial material.
>
> We paid to have it hauled away and then the hauler had to pay again for the dumping or burial privilege. This tacked quite a price on riddance, in the same category as incinerator refuse, burned tins, wire, ashes etc., for which standard disposal charge is about 15 bucks, ten to the trucker and three to five dollars at civic dump per truckload.
>
> The article described certain uses recently developed, such as fertilizer, additional material in bitumastic road surface, concrete building blocks, and insulation additive. This produced nostalgic memories.
>
> Long time ago as a pup engineer in a Hamilton coke-oven gas plant we made a lot of this stuff. One day while cleaning it out of ducts and chimney base I chinned with an observer whose firm supplied clay pigeons for several trapshooting clubs throughout Ontario. He mentioned their efforts and difficulties in securing just the right raw material, took a few bags of fly ash to try out.
>
> These "birds" are thrown mechanically into the air away from a shooting-mound, must be solid enough to stand rough handling and yet shatter if hit by even one shotgun pellet. He came back a week later quite excited, with half a dozen empty barrels, and asked us to save every bit for his firm.
>
> Plant management was glad to be rid of it sans cost, and we happily barrelled a ton or so weekly during three years of my tenure with the company. In fact this arrangement may be going on yet for aught I ken. The pigeon people paid us a dollar per barrel. In those days 12 or 15 bucks a week divided among a few engineers made quite a nice windfall.
>
> This may be one profitable use currently overlooked, in addition to your listing. At least the customer would take it away at his own expense. — *Bert Richards, Toronto, Ontario.*

---

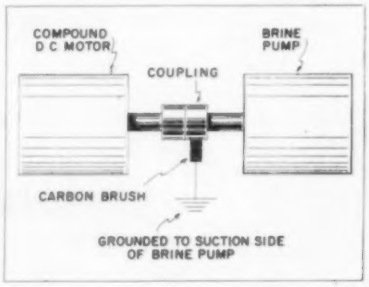
**AN ANSWER FOR ALBERT COSTA.** In reply to Mr. Costa's questions published in *What They Tell Us*, April POWER ENGINEERING, page 6, R. J. K., of Wabash, Ind., wrote:

> Suggest you contact the leading water treatment companies and consultants with reference to your problem. Your water pretreatment is poor. You have a $CO_2$ condition in your condensate which gives you $H_2CO_3$ or carbonic acid. Hardness most likely will give you scale in your boiler. Low pH will deteriorate condensate lines. Both items can be eliminated but equipment is costly and economics will rule.

---

**REASON FOR THE BRUSH** on coupling of brine pump:

> Will you come to my aid with a solution to this problem?
>
> There are two brine pumps in the refrigeration plant in which I am employed. One brine pump is driven by a steam turbine and the other is driven by a compound wound d-c motor.
>
> The coupling of the electrically-driven brine pump is equipped with one carbon brush leading from the coupling to ground. (*See sketch below.*)




> What is the purpose of this brush? How does it accomplish this purpose?
>
> If its purpose is to prevent galvanic action caused by the reaction between the impeller, the brine and the casing, why isn't the turbine pump also equipped with a similar brush?
>
> If it is there to ground stray electric currents from the electric motor, do these currents come from the copper windings or are they eddy currents induced in the steel shaft of the armature?
>
> I will very much appreciate any information you can give me.— *N. B., New York, N. Y.*

The purpose of this brush on the pump is to reduce or eliminate galvanic action in the bearings of the brine pump.

In the motor-driven pump, currents are induced in the motor shaft by the magnetic flux through the shaft. These shaft currents tend to travel along the shaft through the bearings to ground, or the base plate of the unit, and back to the shaft on the opposite end of the rotor.

By placing a carbon brush on the coupling between the motor and the pump, the shaft current is led to ground and so cannot affect the pump. Since there are no shaft currents induced in the turbine-driven pump, no brushes are necessary.

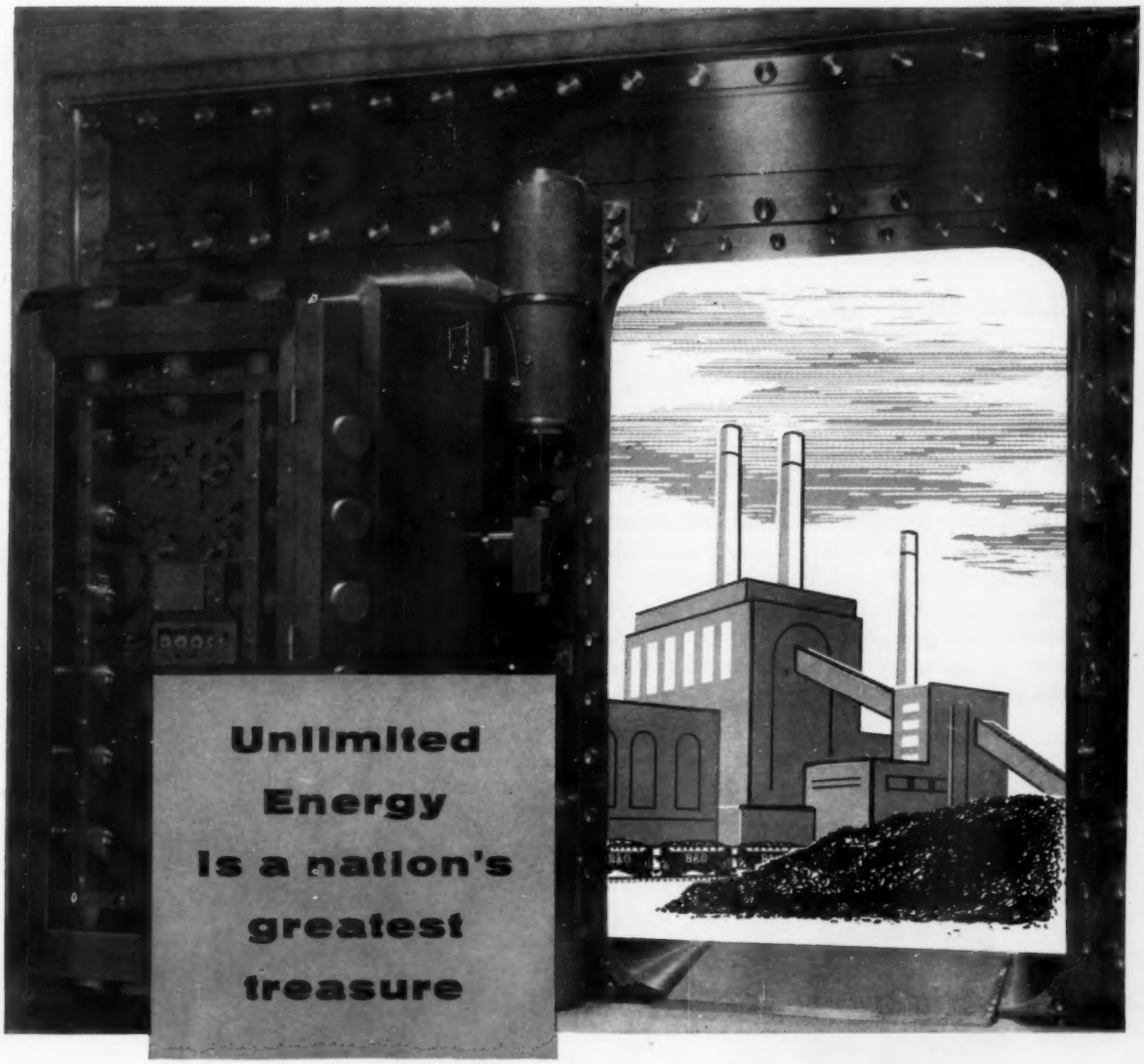
These shaft currents are eddy currents, induced directly in the shaft by the magnetic field in the motor.

We published a very good article on this subject by O. E. Olson of Electric Machinery & Manufacturing Co. in the November 1949 issue of POWER ENGINEERING.

---

**GREENHOUSES?** As a power engineer do you ever wonder about their heating problems? E. T. Orcutt of New Jersey, engaged in the selling of greenhouses, sales and advertising manager for a period of nearly 43 years, sent us these figures:

> Someone has stated that the greenhouse business is a $100,000,000 enterprise. I personally think this is an understatement. The size of a greenhouse plant is determined by the number of square feet of ground that is covered by glass. If a man has a greenhouse 50 ft wide and 500 ft long, he would have 25,000 sq ft of glass. A house of this size would require at least four men or women to plant, cultivate and prepare for market the cut flowers grown therein.
>
> Throughout the Eastern and Middle Atlantic states there are many very large ranges of glass. The owners rely entirely on the manufacturers of greenhouses and their heating systems for advice on structural and heating problems. It is not necessary for them to spend one cent for engineering advice.
>
> Fuel consumption takes about one gallon of #2 oil per hour to heat 400 sq ft of radiation. A greenhouse covering an area of 10,000 sq ft, if heated to 60 degrees when the outside temperature is at zero, would require about 6.5 gal of oil per hour.
>
> The Btu per hour is 61,700 and one must know the Btu in a pound of coal before the quantity per hour can be determined. There is such a variance in types and grades of coal that the cost and quantity vary.
>
> Incidentally, it takes about five times as much heat to heat a greenhouse as any other type of building of like size. And many practices and methods applying to other businesses cannot be applied to greenhouse operation or construction.
>
> I could write a book on practical points in greenhouse construction and operation.




Modern industrial might comes from nature's harnessed energy. This nation's greatest single energy resource is found in its tremendous reserves of Bituminous coal.

As population increases—as living standards rise, vast additional amounts of energy will be required—and found in Bituminous—*the fuel with a future.*

Fields served by B&O contain known reserves of more than 8 billion tons suitable for every purpose. The nation can safely *bank on bituminous* treasure like this and on B&O operators to mine and supply it in greatest quantities, with increasing efficiency at stable-low-cost. *Ask our man!*

*Let our Coal Traffic Representative suggest*
*a constant-low-cost Bituminous coal for your needs—*
COAL TRAFFIC DEPARTMENT
B&O RAILROAD • BALTIMORE 1, MD.
LExington 9-0400

For more data circle 505 on Post Card

# it's **boiler check-up** time!

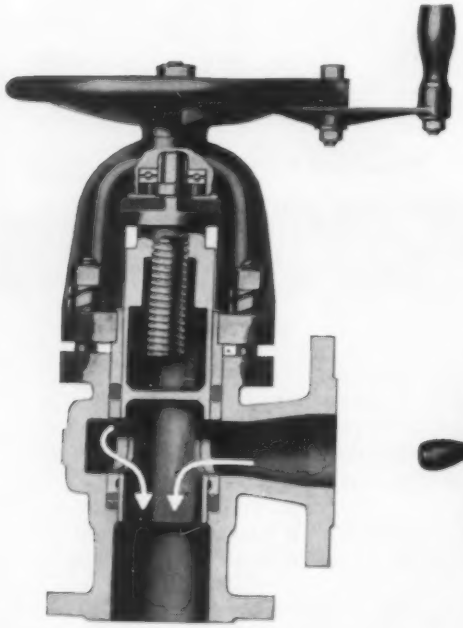
## ✓ HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

Write today for YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals line drop tight—yet permits free, unobstructed flow in blow-down. **Used in over 15,000 boiler plants.**

Yarway Unit Tandem Blow-Off Valve for higher pressures. Combines Yarway Seatless Valve and Yarway Hard-Seat Valve, or two Yarway Hard Seat Valves, in a one-piece forged steel body. For years—the choice of 4 out of 5 high pressure power plants.

YARWAY steam

## ✓WHAT ABOUT WATER COLUMNS AND GAGES?

Are they in good working order? Are they up-to-date?

Is the water level clearly visible from the operating floor? YARWAY Gages equipped with Type "M" Illuminators make the meniscus "shine like a star"—even under adverse conditions.

Now's the time to install modern YARWAY Water Columns and Gages. Twelve distinct improvements in YARWAY Gages have increased gage life—decreased gage maintenance. Write for latest Catalog WG-1812.

## ✓HOW ABOUT ADDING NEW REMOTE LEVEL INDICATORS?

Remote readings of boiler water level at any spot in the plant are a recognized convenience—and easy with "Wide Vision" YARWAY Remote Liquid Level Indicators.

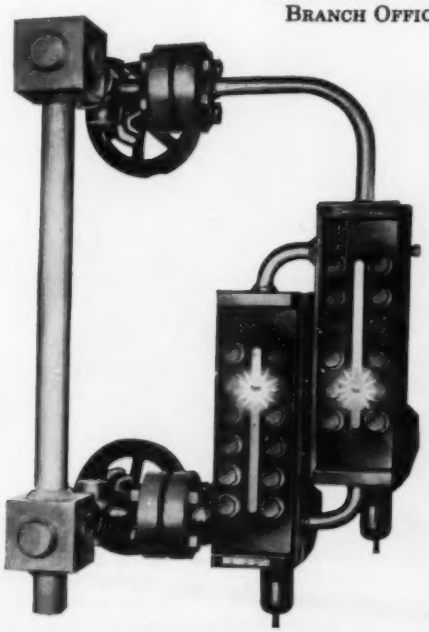
Because the indicating mechanism is operated by the boiler water itself, response is always instant, readings always accurate.

YARWAY Hi-Lo Graph Recorder not only gives remote indication but also a 24-hour recording of water levels.

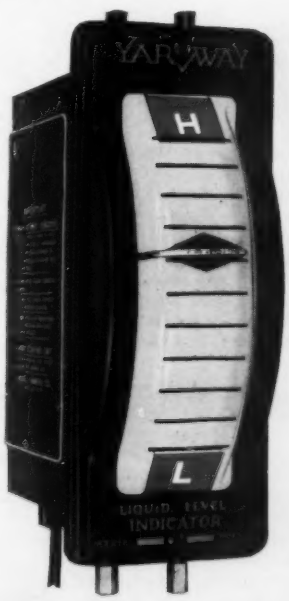
YARWAY Remote Indicators and Recorders can also be supplemented with Remote Hi-Lo Alarm Signals—light or horn.

Write for Catalog WG-1824.

**YARNALL-WARING COMPANY**
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



Yarway high pressure Flat-Glass Water Gage assembly with tie-bar type circulating water column. Note separated design, expansion loops, flanged connections and Type "M" illuminators. Other columns and gages for lower pressures.

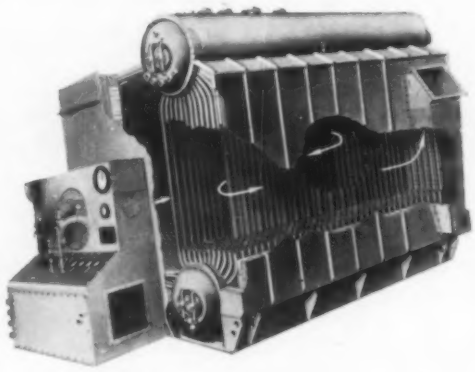



Yarway Remote Liquid Level Indicator with "wide vision" face. Manometric type with automatic temperature compensation where required. Over 10,000 used throughout industry.

**plant equipment**

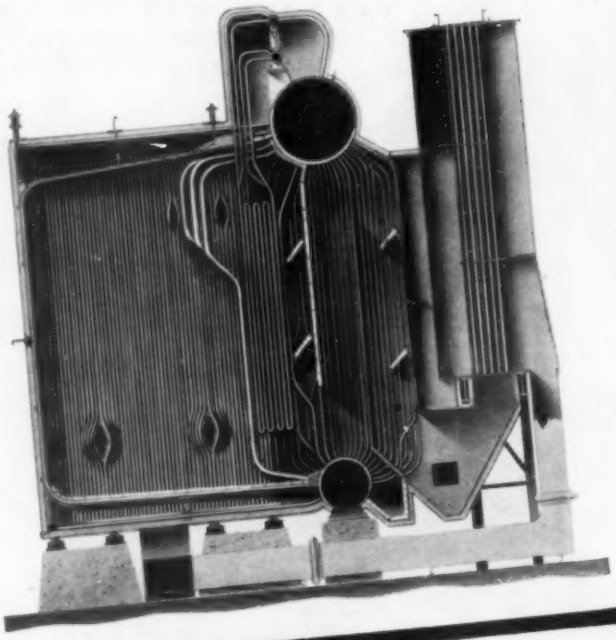
For more data circle 506 on Post Card

# MODERN OIL AND



**C-E Package Boiler—Type VP**

Completely shop assembled . . . available in fourteen sizes from 4,000 to 40,000 lb capacity . . . pressures to 500 psi. Available with integral console control panel, this unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. It can be equipped with any of several approved burners.



**C-E Vertical Unit Boiler —Type VU-55**

Available in six sizes . . . capacities from 50,000 to 120,000 lb steam per hour . . . designed for two pressure ranges, 250 psi and 500 psi, and total steam temperatures up to 750 F. This double cased, gas-tight unit is equipped with tangential burners. A large (60-inch) steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.

# COMBUSTION

**Combustion Engineering Building**

STEAM GENERATING UNITS • NUCLEAR REACTORS • PAPER MILL EQUIPMENT • PULVERIZERS • FLASH DRYING

# GAS FIRED BOILERS

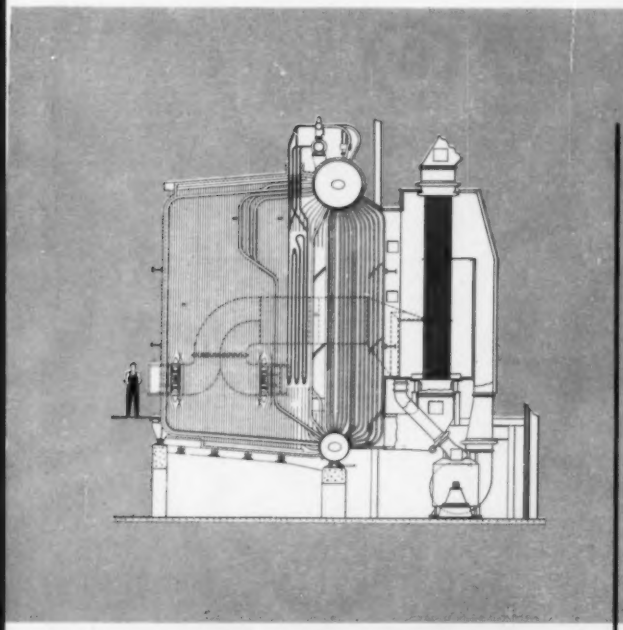
The boilers illustrated here cover the broad capacity range from 4,000 to 600,000 lb of steam per hr. They are all especially designed for gas and/or oil firing. The two units shown on the left page (Types VP and VU-55) are standardized and each is available in several sizes. The capacity range covered by these two units is from 4,000 to 120,000 lb per hr. The two units below are custom designed for various capacity, pressure and temperature requirements up to 600,000 lb per hr, 1400 psi and 950 F. All these units are pressure fired and do not require induced draft fans.

Collectively, they offer an exceptional diversity of choice. A brief consideration of the features of each type will help you "pinpoint" the design characteristics best suited to your particular needs.

Of course there are other C-E two drum Vertical-Unit Boilers available for pressures up to 1400 psi and temperatures up to 960 F. Shown here are but four popular members of the C-E family of Vertical-Unit Boilers—a family which has achieved a wide measure of acceptance using all types of fuel.

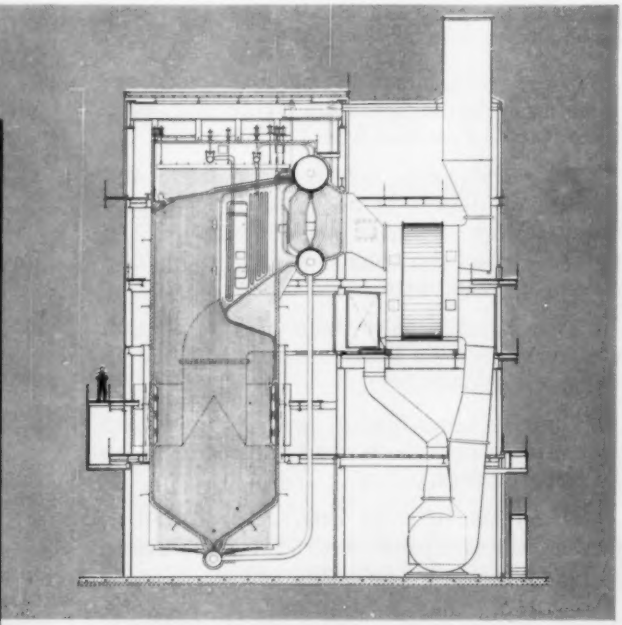
*Please feel free to call on us for further detailed information. Catalogs are available upon request.*

B-922



**C-E Vertical Unit Boiler—Type VU-50B**

This unit is available for capacities from 50,000 to 400,000 lb per hr—pressures to 1400 psi and temperatures to 950 F. This bottom-supported design uses tilting tangential burners providing effective superheat control. Horizontal burners can be furnished if desired. Heat recovery equipment as required. This unit makes available to industrial installations a standard of performance comparable to utility practice.



**C-E Vertical Unit Boiler—Type V2**

This unit is available for capacities from 200,000 to 600,000 lb per hr. It can be designed for pressures up to 1400 psi and for temperatures to 950 F. Tilting tangential burners, providing superheat control, are standard equipment although horizontal burners are available, if desired. A double, gas-tight casing assures lifetime tightness and minimum heat loss. Heat recovery equipment can be furnished as desired.


**ENGINEERING**

CE

200 Madison Avenue, New York 16, N. Y.

SYSTEMS • PRESSURE VESSELS • HOME HEATING AND COOLING UNITS • DOMESTIC WATER HEATERS • SOIL PIPE

**For more data circle 507 on Post Card**

## *"We found by actual tests that FUSETRON dual-element FUSES would eliminate Motor Burnouts on our Welders"*

*"Here are the facts . .*

"In 1946 we were having trouble with single phasing and subsequent burnout of our 3-phase welders. Motor repairs and replacements, plus the down-time was very costly.

"Could this situation be corrected, we wondered, by individually protecting each welder with Fusetron fuses?

"We ran our own test to find out. On 400 ampere welders — 3 pole fuse blocks were mounted in a steel enclosure. 80 ampere, 250 volt Fusetron fuses were installed on the load side of the enclosure.

"The circuits were then single phased. On every test the Fusetron fuses opened in 21 to 23 seconds.

"On checking further with a hook ammeter we found the locked rotor current to be 325 amperes.

"As a result of these tests, we protected all 62 welding machines with Fusetron fuses in the proper motor protection sizes.

"Sure, since then we have blown a number of fuses — but we have not had one motor burnout due to single phasing. Fusetron fuses have certainly cut costs for us.

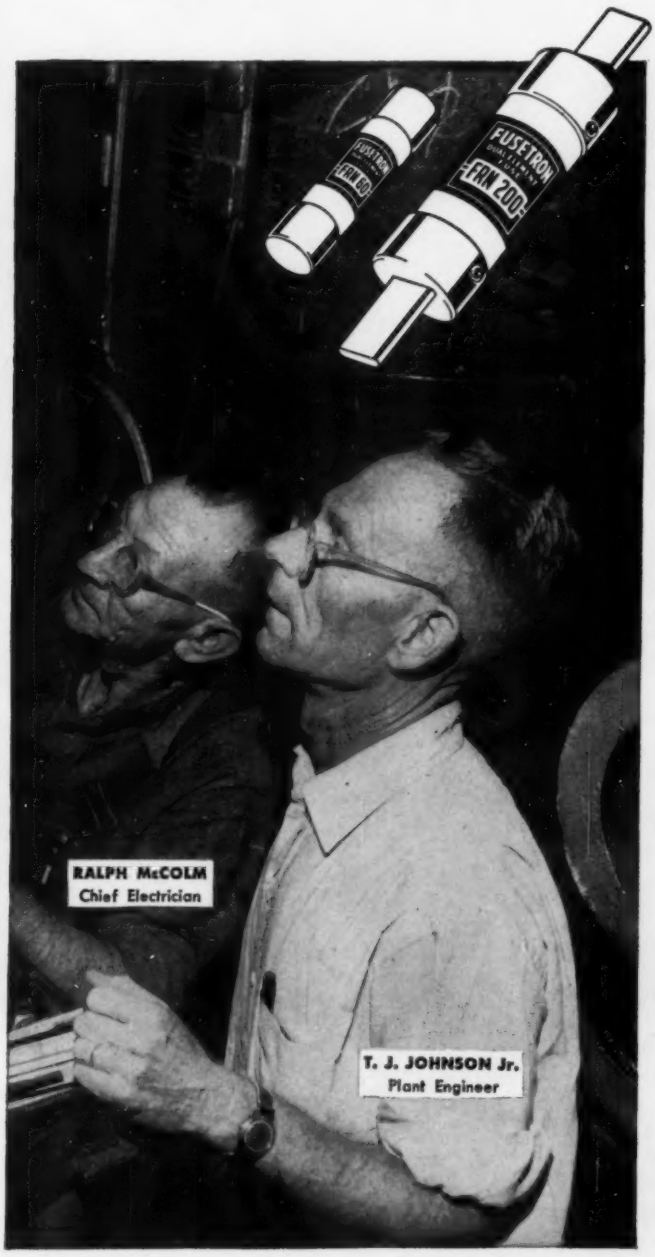
"Today, there are 147 welding machines in operation and each is protected with Fusetron fuses."

*Ralph McColm*
CHIEF ELECTRICIAN
BLACK SIVALLS AND BRYSON, INC.
OKLAHOMA CITY, OKLA.

## why Fusetron Fuses can protect motors against burnout

Fusetron fuses have a tremendous time-lag. This means, on normal installations, Fusetron fuses can be used in motor-running protection sizes — without opening on motor-starting current or other harmless overloads.

When so used, Fusetron fuses protect motors from any harmful excess of current caused by such things as single phasing, overloading, wrong voltage, being stalled, lack of oil, tight belt, worn bearings or anything that causes the motor to draw a dangerously excessive current.




## Fusetron Fuses provide simplest way to prevent damage from single phasing

When single phasing occurs, the current in the remaining phase increases about 100%. (Theoretically 73%, but change in efficiency and power factor makes it about 100%).

This 100% overload on Fusetron fuses of motor-running protection size opens them and stops flow of current to the motor.

## FUSETRON FUSES DO MORE THAN PROTECT MOTORS AGAINST BURNOUT

*They provide 10 Point Protection*

1. High interrupting capacity — protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.
2. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
3. Protect against needless blows caused by harmless overloads.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect against waste of space and money — permit use of proper size switches and panels.
6. Protect motors against burnout from overloads.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Protect motors against burnout due to single phasing.
9. Make protection of small motors simple and inexpensive.
10. Protect coils, transformers and solenoids against burnout.

*More information on Fusetron dual-element fuses is available. Write for bulletin FIS.*

**FOR LOADS ABOVE 600 AND UP TO 5000 AMPS. — USE BUSS Hi-Cap FUSES!**

On 600 volts or less, they have interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

*Write for bulletin HCS.*

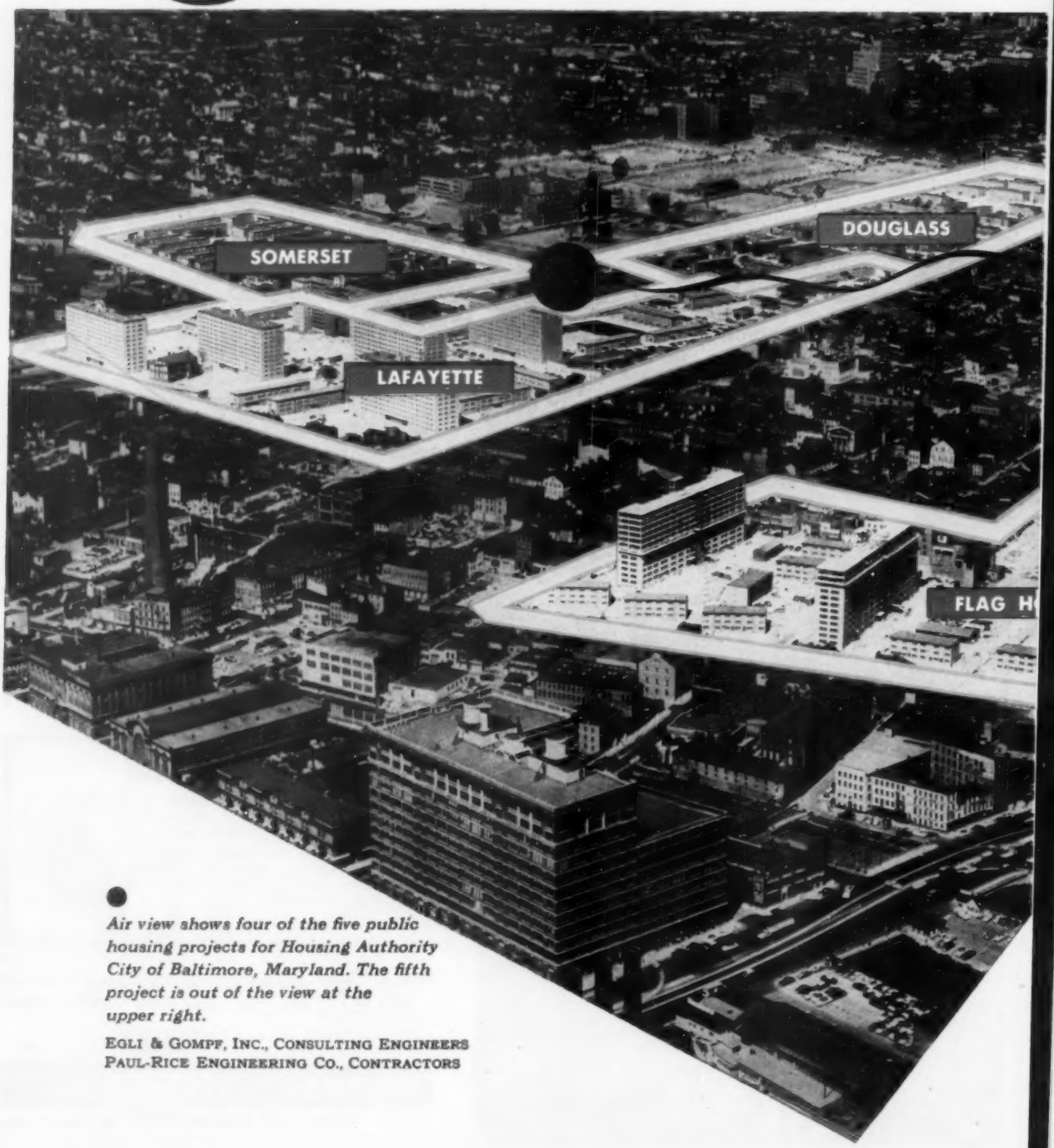
***Play Safe!*** *Install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

**BUSSMANN MFG. CO.** FUSETRON BUSS Div. of McGraw Electric Co.

University at Jefferson, St. Louis 7, Mo.

For more data circle 508 on Post Card

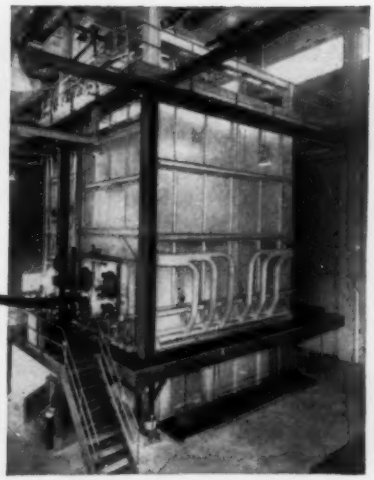
# 5 Baltimore public housing to save $70,000

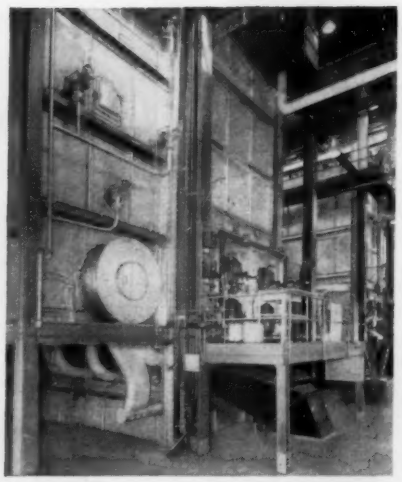



*Air view shows four of the five public housing projects for Housing Authority City of Baltimore, Maryland. The fifth project is out of the view at the upper right.*

EGLI & GOMPF, INC., CONSULTING ENGINEERS
PAUL-RICE ENGINEERING CO., CONTRACTORS

# projects consolidate heating plants ANNUALLY ---





**2 Erie City 120,000 lb/hr boilers serve 2804 families**

The Engineering firm of Egli & Gompf, Inc., gave careful consideration to the hot water and heating requirements for the two new housing projects in addition to three existing projects. Studies compared the annual costs of five existing boiler plants and two new boiler plants for the new projects against a single large centrally located heating plant. The final analyses show that consolidating all of the hot water and heating requirements into one plant would save more than $25.00 per family per year or a total of $70,000.00 annually.

Erie City, with over a century of steam generating experience, can help you to greater steam economy and dependability. Erie City designs and manufactures boilers and the complete line of components, including firing equipment, offering single responsibility for erection, performance and service. Write for general catalog SB-503.

ERIE CITY
116 Years in Steam Generation

*You can depend on Erie City for sound engineering*

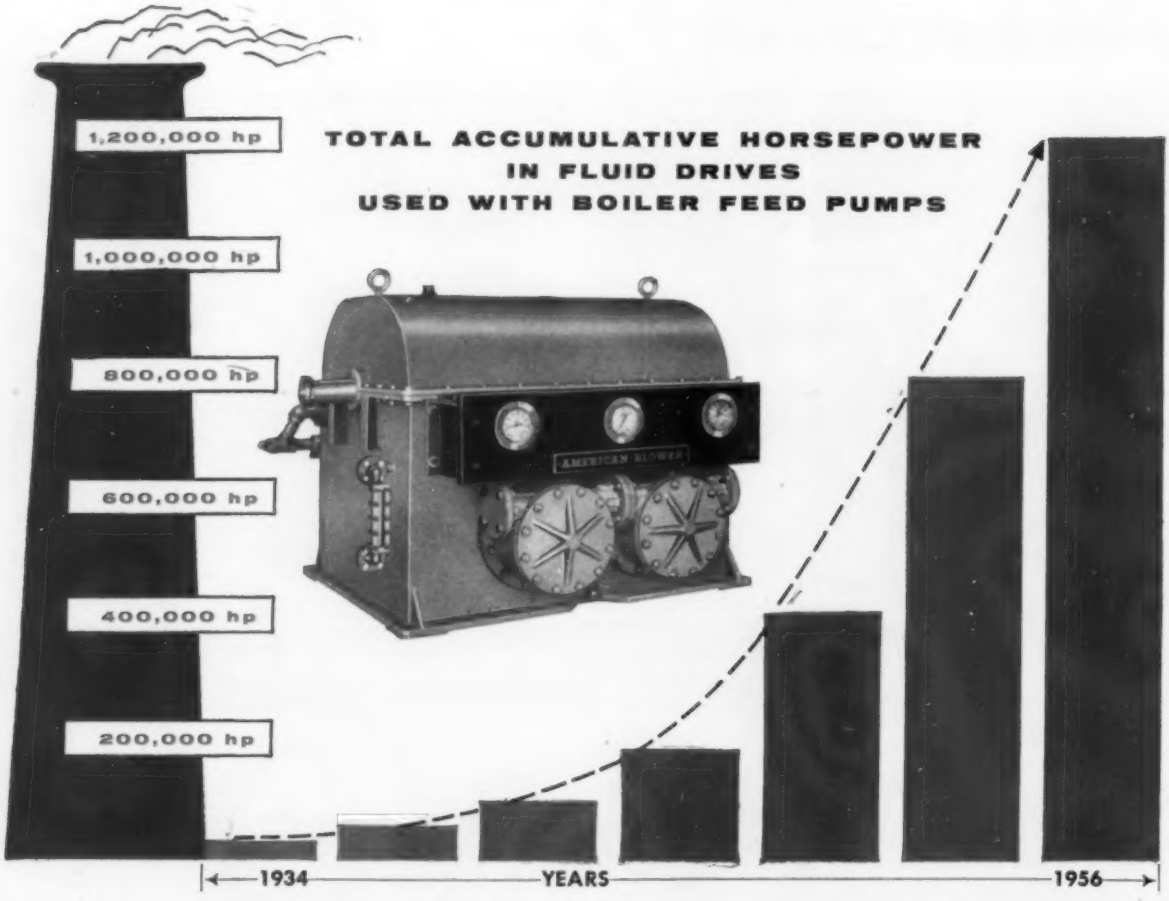
**ERIE CITY IRON WORKS** • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

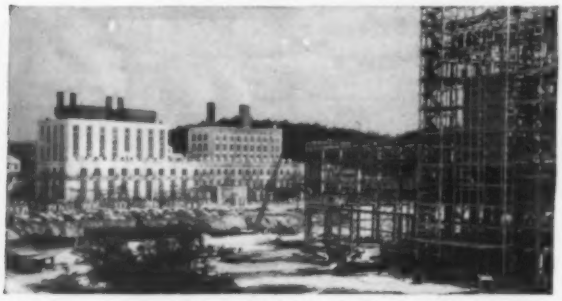
For more data circle 509 on Post Card

AMERICAN BLOWER REPORTS ON PROGRESS IN POWER:

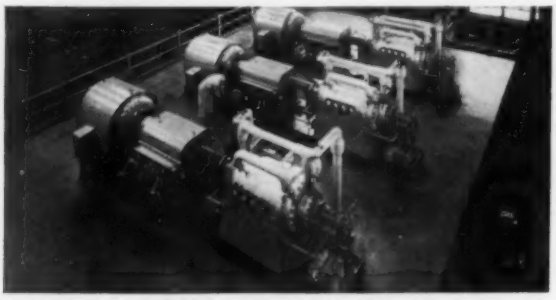
# The big swing is to Gýrol® Fluid




**Accelerated industry-wide acceptance.** Beginning in the late 1930's, demands for higher pump pressures resulted in the high-speed boiler feed pump. Consulting and utility engineers turned to Fluid Drive because of power savings from adjustable-speed operation. As a result, new quick-response, close-control Fluid Drives were developed specifically for feed-pump service. Rapid acceptance is shown on graph above. By 1957 there will be in operation in the U.S. close to 1,200,000 hp on feed pumps employing Gýrol Fluid Drives.



**In the past ten years,** about 250 new generating units (total capacity: 25 million kw) have employed Fluid Drive on the feedwater pumps. This number will jump sharply. For, present U.S. capacity of 100 million kw is expected to increase by 275% within 25 years.



**TODAY,** Gýrol Fluid Drives save power in plants using conventional fuels, and tomorrow will figure prominently in atomic-powered systems. Stepless speed control of Fluid Drives also saves power on mechanical draft fans; simplifies motors and starting.

# Drive for feed pump control!

**Here's how power plants of all sizes are using American Blower Gýrol Fluid Drive to prolong equipment life, reduce pressure, save power!**

**To make more net generating capacity** available to consumer lines, more and more power plants of all sizes are turning to Gýrol Fluid Drive to transmit power from the prime mover to the pump.

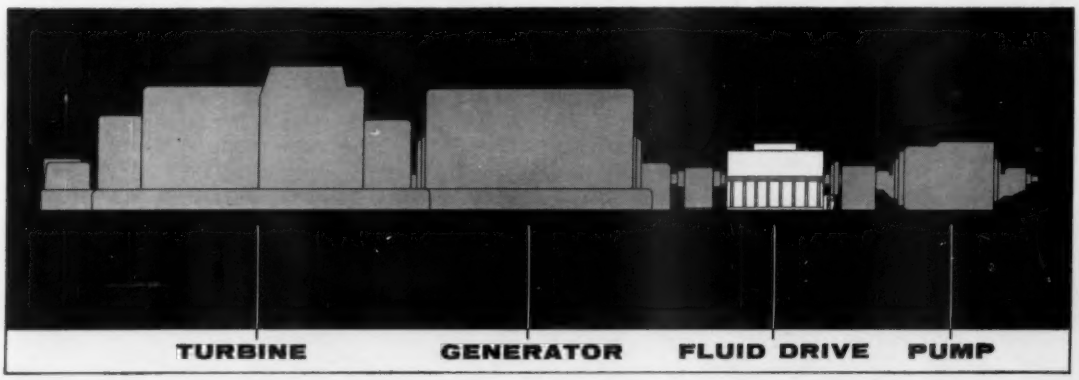
**For, of all power-plant auxiliaries,** the boiler feed pump and its prime mover consume the greatest single segment of invested power: an average 2.5%. And, with higher steam pressures and temperatures, estimates of 4% to 6% are being discussed for the immediate future—indicating the necessity for power-saving adjustable-speed pump control through the use of Fluid Drive.

**The reason for the big swing** to Gýrol Fluid Drive lies in the inherent advantages it offers. The use of Gýrol Fluid Drive results in a substantial savings in power, since on present-day, modern high-pressure boiler installations it permits reduction in pressure by use of the Gýrol Fluid Drive's adjustable-speed feature. This reduction in pressure often amounts to 500 lbs. or more.

**Through the use of Fluid Drive,** the boiler feed pump need only be driven at speed necessary to overcome system friction and boiler pressure. This results in lower pump operating speeds; lower duty on piping, high-pressure heaters, and valves—reducing maintenance and extending equipment life.

**In the power-plant industry,** Fluid Drive is renowned for its flexibility of control. The narrow range of speed over which a boiler feed pump must operate requires fine increments of speed adjustment, coupled with the need for quick response. The stepless, infinitely adjustable speed control of Gýrol Fluid Drive, together with its rapid response, more than meets this requirement. The Gýrol Fluid Drive has been engineered and designed to be conveniently linked to standard boiler feed water automatic control systems.

**In your plans for power expansion,** it will pay you to talk to an American Blower engineer. His knowledge of the application of Gýrol Fluid Drives, and American Blower's many other power-plant products, can prove invaluable to you. Just contact your nearest branch office, or write to us direct. American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco Company, Ltd., Windsor, Ontario.




**THINGS TO COME.** World's largest boiler feed pump—now being built for Consolidated Edison Co. of New York, Inc.—employs a new concept of drive: the main generator steam turbine. Twice as large as any feed pump now in existence, pump is rated at 12,000 hp, with power transmitted through an American Blower Type VS, Class 6 Gýrol Fluid Drive. For full details on American Blower equipment —Fluid Drives, Mechanical Draft Fans, Fly Ash Precipitators, Dust Collectors, Heavy Duty Steam Coils—contact our nearest branch.

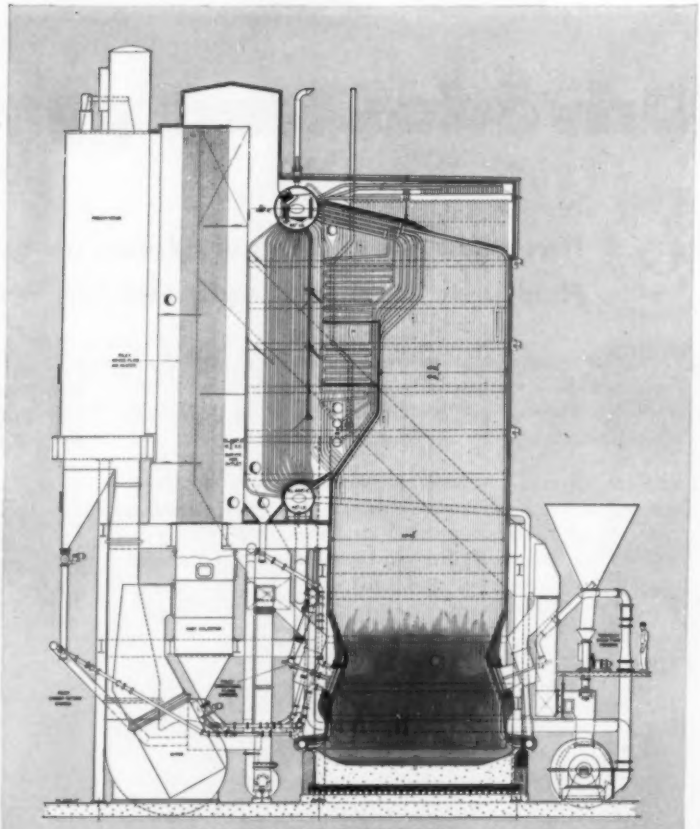
**AMERICAN BLOWER**

Division of AMERICAN-Standard

**For more data circle 510 on Post Card**

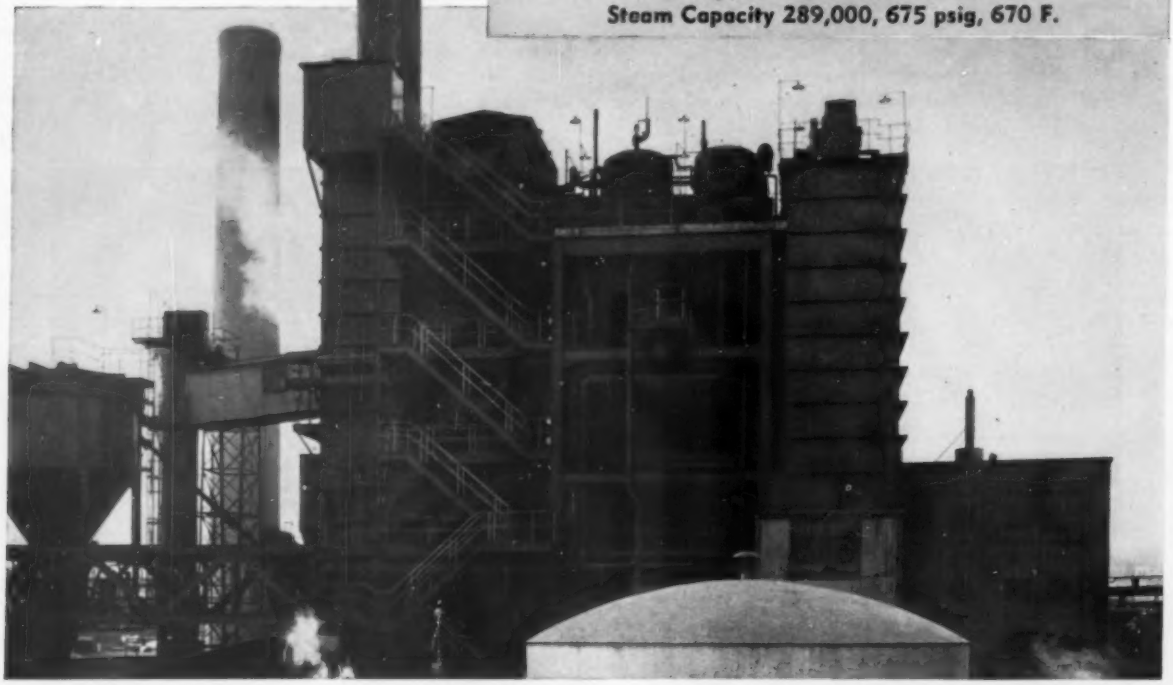
**A 1955 POWER MODERNIZATION AWARD WINNER**

This 289,000 lb./hr. Riley TURBO FURNACE Unit replaces several low capacity, low efficiency units and is part of a modernization program that has resulted in a total of $470,000 annual savings on the making of steam by the original boilers. A considerable part of this saving is due to the TURBO FURNACE Unit's high efficiency, low carbon loss in fuel, lower maintenance, elimination of flyash disposal problem.



**Riley TURBO FURNACE unit**
**Steam Capacity 289,000, 675 psig, 670 F.**

One of two TURBO FURNACE Units and one of a total of 26 Riley Units purchased by this chemical company . . . a total steam generating capacity of *five and one half million pounds per hour!*



***A survey of your plant by a consulting engineer could show you ways of making surprising savings in your power costs.***

# TURNS FLYASH INTO PROFITS

## for prominent West Virginia Chemical Company

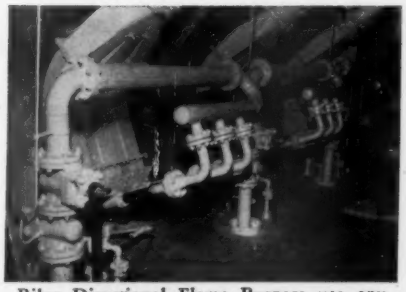
## The *New* RILEY

# TURBO FURNACE

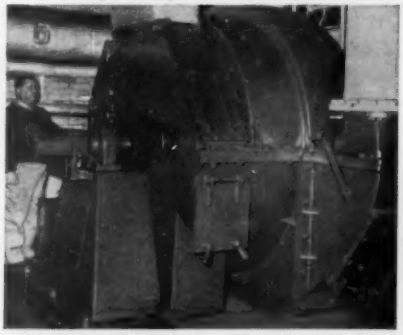
Once flyash disposal was a major problem for this company. Today Riley TURBO FURNACE Units are helping to solve this problem. At Plant (A) flyash is reinjected into the TURBO FURNACE combustion zone where high heat concentration and extreme turbulence converts ash to slag; when tapped and cooled, slag is easily disposed of, resulting in a usable product and a substantial savings in net cost of plant operation. At Plant (B) another Riley TURBO FURNACE unit successfully burns its own flyash . . . and even flyash from an adjacent dry bottom unit.

**. . . in addition to eliminating flyash disposal, the Riley TURBO FURNACE also offers users these advantages:**

- **Will burn efficiently a wide range of coals, oil, gas, lignite, delayed coke, and fluid coke.**
- **Low carbon loss increases unit efficiencies, lowers fuel cost.**
- **Clean heating surfaces do away with slag blowers.**
- **No stratification of furnace gases.**
- **Furnace exit gas temperatures are the same regardless of fuel.**
- **No change in pressure parts needed when converting to solid fuels.**
- **One level burner operation.**
- **Higher heat release rates: lower overall height.**



Riley Directional Flame Burners use any fuel or combination of fuels; available with complete sequential automatic control.



Riley 550 Pulverizers with Tungsten Carbide faced grinding elements resist wear and reduce maintenance.

**UNITS WITH RILEY TURBO FURNACES ARE DESIGNED FOR ANY CAPACITY, PRESSURE, TEMPERATURE**

TURBO FURNACE Units have been purchased by *Delaware Power & Light Co.* — three 500,000 lbs./hr. units designed for firing fluid coke; *Texas Electrice Service Co.* — 825,000 lbs./hr. reheat unit designed for firing gas, oil and Texas lignite; *Louisiana Power & Light Co.* — one 1,550,000 lbs./hr. reheat unit designed for firing gas, oil, coal and fluid coke; *Kaiser Aluminum & Chemical Corp.* — two 320,000 lbs./hr. units for gas and oil, future coal.

*Consult your Riley Representative in these cities for complete details about the Riley TURBO FURNACE.*

**Worcester, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.**

# RILEY

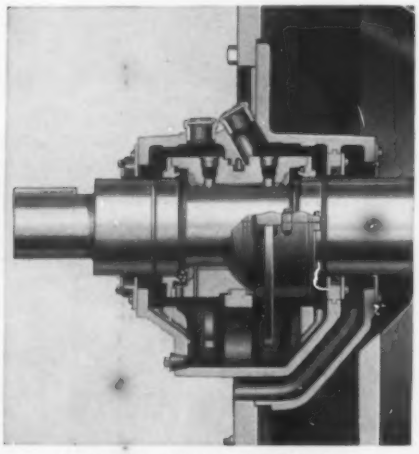
*Stoker Corporation*

WORCESTER, MASSACHUSETTS

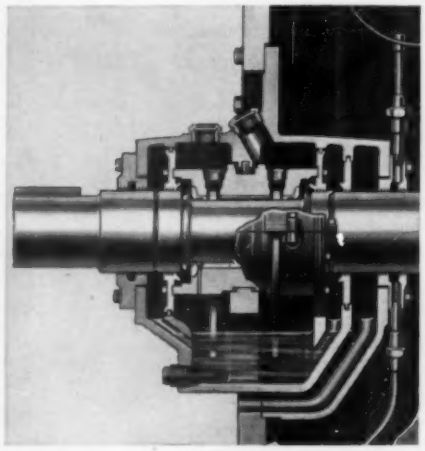
**For more data circle 511 on Post Card**

# NEW Bearing Design Means Better Motor Performance

## Allis-Chalmers capsule-type sleeve bearings now perfected for complete motor line



Standard capsule-type sleeve bearing



High speed capsule-type sleeve bearing

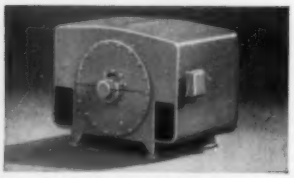
**A new feature**—an improved capsule-type bearing design—has been added to the Allis-Chalmers complete line of large end-shield bearing motors. This new bearing will give you better motor service, simplified maintenance and longer motor life through features like:

- Dust-tight, leakproof enclosure protects bearing from dirt, dust or abrasive materials.
- Venting system prevents oil leakage — keeps oil and vapor from getting into motor enclosure.
- Dual oil-rings insure bearing surface lubrication — either ring can adequately lubricate bearing.
- Split end-shield gives easy accessibility to winding and air gap — without disturbing capsule or bearing alignment.

Drip-proof or splash-proof cage motor

Synchronous or wound-rotor motor

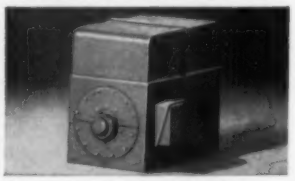
High speed cage motor



Weather-protected motor

Totally-enclosed fan-cooled motor

Totally-enclosed forced-ventilated motor



Water-cooled or inert-gas-filled motor

Capsule-type bearings are standard on these Allis-Chalmers motors.

### You get **MORE** from Allis-Chalmers motors

More design and construction features — more application help. For complete information, contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

# ALLIS-CHALMERS

A-5032

For more data circle 512 on Post Card

R.V.S.
Edward has the original and only complete line of carbon and stainless steel all-forged instrument valves. These features will save us money.
B. J. B.

**ROCKWELL BUILT**
***Edward Valves***

Bronze yoke bushing and fine stem threads wear longer, operate easier, adjust flow better.

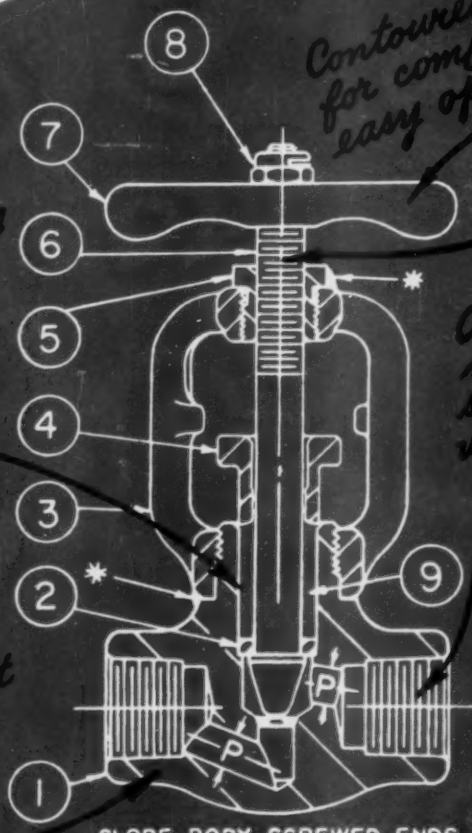
Contoured "T" handle for comfortable, easy operation.

Deep packing chamber high grade packing combine to minimize maintenance.

Drop forged heat-treated body provides strength and freedom from porosity without excess weight.

Accurately machined screwed or socket welding ends.

Let's have Edward supply all instrument valves and other steel valves on our new units.




GLOBE BODY-SCREWED ENDS

LIST OF MATERIAL
QUANTITIES ARE FOR ONE GLOBE OR ONE ANGLE VALVE
WHERE A.S.T.M SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

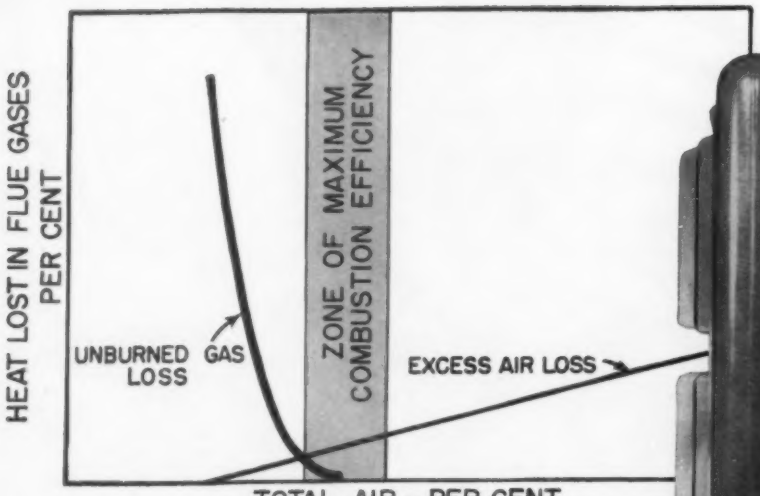
| PIECE NO. | NAME OF PIECE | NO. REQ'D | MATERIAL | SPECIFICATIONS | EDW MS NO. |
|---|---|---|---|---|---|
| 1 | BODY | 1 | FORGED STEEL 0.30% MAX. C | A.I.S.I. C1029 | 114 |
| 2 | JUNK RING | 1 | EVALLOY | A.S.T.M A182 GRADE F8 | 212 |
| 3 | YOKE | 1 | FORGED STEEL | A.S.T.M A105 GRADE II | 111 |
| 4 | GLAND | 1 | FORGED STEEL EVALIZED | A.S.T.M A105 GRADE II | 111 |
| 5 | YOKE BUSHING | 1 | BRONZE | A.S.T.M B21 | 442 |
| 6 | STEM | 1 | STAINLESS STEEL 13% CHROMIUM | A.I.S.I. TYPE 416 | 219 |
| 7 | T-HANDLE | 1 | MALLEABLE IRON | A.S.T.M A47 GRADE 32510 | 322 |
| 8 | LOCK NUT | 1 | STEEL | COMMERCIAL | |
| 9 | PACKING | | EVALPAK | HIGH TEMPERATURE PACKING | 501 |
| 10 | GLAND BOLT | 2 | FORGED STEEL EVALIZED | A.I.S.I. C1120 | 123 |
| 11 | BOLT WASHER | 2 | STEEL | | |
| 12 | BOLT NUT | 2 | STEEL-EVALIZED | A.S.T.M A194 CLASS O | 124 |
| 13 | DISK | 1 | STAINLESS STEEL WITH STELLITED SEATING FACE | A.S.T.M A193 GRADE B8F | 257<br>481 |

EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

FORGED STEEL INSTRUMENT
GLOBE AND ANGLE VALVES
GENERAL ASSEMBLY

| | | |
|---|---|---|
| DRAWN | | CE-3430 |
| CHK'D | | |
| APP'D | DATE | |

Edward builds Globe and Angle Stop, Non-Return, Check, Stop-Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.


HEAT LOST IN FLUE GASES PER CENT
UNBURNED GAS LOSS
ZONE OF MAXIMUM COMBUSTION EFFICIENCY
EXCESS AIR LOSS
TOTAL AIR - PER CENT

The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

# BAILEY announces . . .
# New 2 in 1 way to measure Combustion Efficiency

The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:

**1. Excess air**—regardless of the fuel or combinations of fuels being burned.

**2. The mixing efficiency of your fuel-burning equipment**—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. P31-1

BAILEY METERS

## BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

INSTRUMENTS AND CONTROLS

*For Power And Process*

For more data circle 514 on Post Card

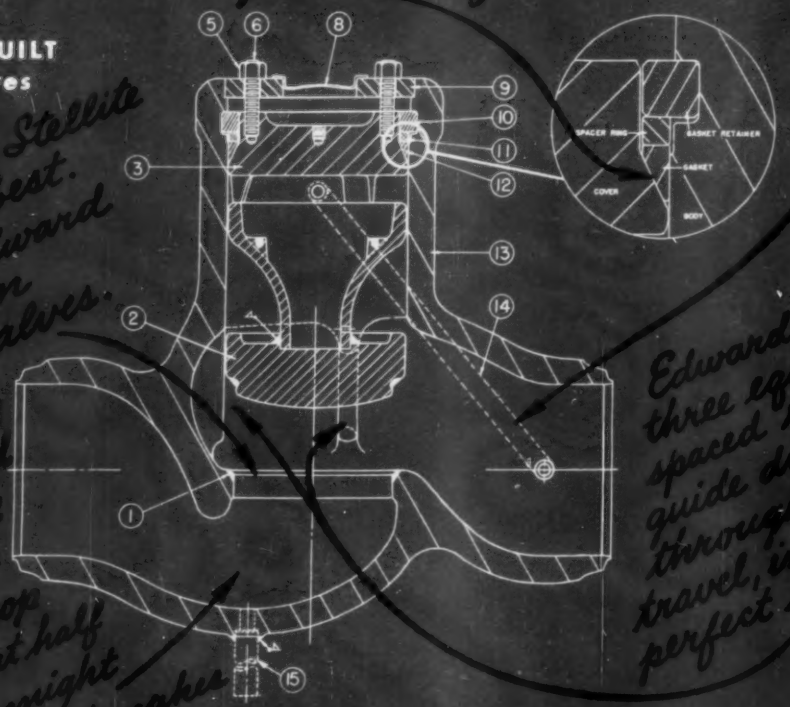
R.S.B.
Edward checks are competitively priced yet we get many "extras."
M. A. L.

Equalizer aids disk-piston lift, reduces motion and extends life of guiding surfaces. These piston checks seat tightly and have non-slam characteristics.

Here is a really dependable Pressure-Seal gasket — seals over a much wider area. Edward inlays body for excellent gasket surface.

**ROCKWELL BUILT**
***Edward Valves***

Integral Stellite seat is best. Only Edward has it on large valves.




Streamlined body really helps. Pressure drop is only about half what you might guess. Edward makes streamlined angle check valves too.

Edward uses three equally spaced ribs to guide disk throughout travel, insuring perfect seat.

Let's have Edward quote on the checks as well as all steel valves on our new job.

LIST OF MATERIAL
QUANTITIES ARE FOR ONE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

| PIECE NO. | NAME OF PIECE | NO. REQ'D | MATERIAL | A.S.T.M. SPECIFICATIONS | EDWARD MS NO. |
|---|---|---|---|---|---|
| 1 | SEAT | 1 | INTEGRAL WITH BODY | STELLITED | 481 |
| 2 | DISK | 1 | FORGED ALLOY STEEL WITH STELLITED SEATING FACE | A.S.T.M. A182 GRADE F11 WITH CO2%MAX.CR1¼% MO.½% | 227 481 |
| | PISTON WELDED TO DISK | 1 | CAST STEEL | A.S.T.M. A216 GRADE WCB | 108 |
| 3 | PRESSURE SEAL COVER | 1 | CAST STEEL C-0.25% MAX. | A.S.T.M. A217 GRADE WCI | 209 |
| | | | | | |
| 5 | COVER STUD NUTS | | STEEL | A.S.T.M. A194 GRADE 2H | 127 |
| 6 | COVER RETAINER STUDS | | ALLOY STEEL | A.S.T.M. A193 GRADE B7 | 208 |
| | | | | | |
| 8 | COVER RETAINER COVER | 1 | STEEL | | |
| 9 | COVER RETAINER | 1 | STEEL PLATE | A.S.T.M. A212 GRADE B | 115 |
| 10 | GASKET RETAINER | 1 | EVALLOY | A.S.T.M. A182 GRADE F8 | 212 |
| 11 | SPACER RING | 1 | STEEL | | |
| 12 | PRESSURE SEAL GASKET | | ARMCO IRON-90 BHN MAX. | MALLEABLE PLATED | 506 |
| 13 | BODY | 1 | CAST STEEL C-0.30% MAX. | A.S.T.M. A216 GRADE WCB | 108 |
| | | | CAST STEEL C-0.20% MAX. | A.S.T.M. A217 GRADE WC6 | 226 |
| | | | CAST STEEL C-0.18% MAX. | A.S.T.M. A217 GRADE WC9 | 248 |
| 14 | EQUALIZER | 1 | CHROME MOLYBDENUM | SCHEDULE 160 PIPE | 229 |
| 15 | DRAIN NIPPLE | 1 | CHROME MOLYBDENUM | SCHEDULE 160 PIPE | 229 |

EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

EDWARD PRESSURE SEAL
CAST STEEL HORIZONTAL CHECK VALVE
GENERAL ASSEMBLY

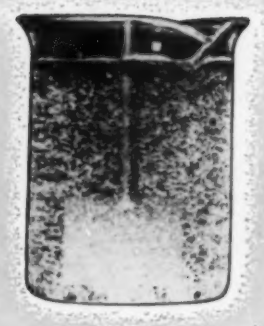
| DRAWN: | APP'D: | DRAWING NO. |
|---|---|---|
| CHK'D. | | AE-3316-6 |
| APP'D. | DATE 4-1-35 | |

Edward builds Globe and Angle Stop, Non-Return, Check, Stop-Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

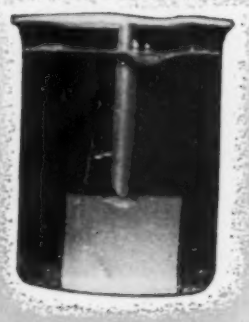
# A New, Better Coagulant

# NALCO 600

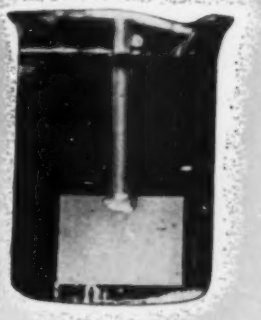
## POLYELECTROLYTE



Alum



Alum plus
typical polyelectrolyte



Alum plus
Nalco 600

● As a coagulant in water clarification, and under many process coagulation conditions, new and different Nalco 600 has shown such great promise, both in performance and economy characteristics, that it has now been made available for general use as an established member of the Nalco family of chemical aids to industry.

Extremely difficult coagulation conditions provide especially economical applications for Nalco 600. It can be used alone or in conjunction with other coagulants. A very low dosage of Nalco 600 usually permits as much as 50% reduction in dosage of alum, activated silica, iron sulfate or clay type treatments . . . and results in a cleaner, clearer supernatant liquid.

Nalco 600 was invented in the Nalco Laboratories, and is being manufactured *only* by Nalco. For complete data on Nalco 600, and expert technical assistance to solve your clarification and coagulation problems, call Nalco now.

**NATIONAL ALUMINATE CORPORATION**
Telephone: POrtsmouth 7-7240
6224 West 66th Place • Chicago 38, Illinois
IN CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S. p. A. SPAIN: Nalco Espanola, S. A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH

**ANOTHER** *Nalco*® **PRODUCT. Serving Industry through Practical Applied Science**



For more data circle 516 on Post Card

# HELPFUL BULLETINS

## ELECTRICAL EQUIPMENT

**101 D-C Motors, Generators** — Bulletin GEA-6355, 12 pp, describes manufacturer's new Kinamatic d-c motors, 1 to 150 hp, built to NEMA standards. Information is given on electrical and mechanical features, versatility of the standard line, features for easier maintenance, plus dimensions and ratings. A companion publication, Bulletin GEA-6461, 6 pp, describes Kinamatic generators, ¾ to 100 kw. General Electric Co.

**102 Outdoor Motors** — Construction features of weather protected motors for outdoor installation are described in Bulletin 05B7874B. It is noted that while such motors are available in all commonly used ratings 250 hp and above, the features described in this bulletin apply to the larger machines. A cross section diagram shows mechanical details of a typical 700-hp, 2300-v, 1185-rpm squirrel-cage induction motor. Allis-Chalmers Mfg. Co.

**103 Manual Motor Starters** — Bulletin GEA-6358, 8 pp, gives new application information on company's CR-1061 and CR-1062 manual starters for fractional and integral horsepower motors to 7½ hp. Illustrated with photos and diagrams, bulletin includes enclosure and dimension data. General Electric Co.

**104 Fuse Cutouts** — Catalog CB 56, 16-pp, describes oil fuse cutouts in three voltage ratings and with interchangeable entrance fittings for lead covered or neoprene jacketed cables. Includes oil fuse cutouts dimensions and data on short circuit interrupting ratings and application. G & W Electric Specialty Co.

**105 Disconnecting Switches** — This 6-pp bulletin describes the complete line of B-2K single-pole outdoor, hook operated disconnecting switches. Illustrated bulletin explains switch design, construction, and operation. Types for upright, vertical, and inverted mounting, with ratings from 7.2 to 115 kv; 400, 600, and 1200 amp, are listed. Tables give catalog numbers, nominal ratings, and dimensions, as well as maximum design voltage, impulse withstand voltage, and momentary current ratings. Delta Star Electric Div., H. K. Porter Co., Inc.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the Reader Service Cards on page 123.

**106 Distribution Transformers** — Catalog 3-500, 32 pp, provides design and product data on single- and three-phase distribution transformers, with high-voltage ratings from 480 to 15,000 v. Thirty-eight data tables are given for single-phase transformers with high-voltage ratings within 480 to 15,000-v range. Three-phase transformer data is supplied in 22 tables. Kva ratings, physical dimensions, weights, losses, efficiencies at full and partial load, and per cent regulation for 1.0 and 0.8 power factor are listed. Gradner Transformer Div., Federal Pacific Electric Co.

**107 Network Transformers** — Operating features of company's oil and Chlorextol liquid-filled and sealed dry-type transformers are discussed in 24-pp Bulletin 61B6152B. Describes electrical assembly of units, tap changer, and tank design, construction, mechanism and accessories. Allis-Chalmers Mfg. Co.

**108 Distribution Transformers** — Bulletin CS-201, 8 pp, features conventional distribution transformers — 167 kva and below. Includes generous cutaway views of construction, description of features, manufacturing processes and quality control procedures. Emphasis is given to core and coil construction, with illustrated explanations on materials, design. Kuhlman Electric Co.

**109 Relay Maintenance** — Data Sheet 156UB features a general discussion of protective relay maintenance and testing with particular attention to equipment and records necessary for assuring safely operative relays and breakers. Describes types of test equipment commercially available, auxiliary instruments for trip-time calibration, standard means for conducting tests and routine to follow. Comparison table of various techniques in current application, and hook-up schematics are included. Multi-Amp Corp.

**110 Electrical Tapes** — This 12-pp booklet — Form 74-10-50 — is designed as a guide to the selection of the electrical tapes best suited for every insulating and protecting application in electrical construction, maintenance and manufacturing. Contains illustrations, technical data, characteristics and performance specifications for plastic, rubber, and vinyl and color electrical tapes. Dutch Brand Div., Johns-Manville.

**111 Electrical Tapes** — Bulletin P6-1 describing company's newly packaged line of electrical tapes lists each tape by its composition and function. Features four types — a polyethylene, vinyl, plastic coated and cloth tape — and gives advantages of each. Polyken Sales Div., The Kendall Co.

**112 Carbon Brushes** — Catalog 56 is a 36-pp technical reference manual on carbon brushes for industrial and other applications. Includes description of grades, table of average characteristics, application information and recommendations, illustrations of brush styles and brush connections. Also covers methods of manufacture, company's engineering facilities and provides data on dimensions and tolerances. Pure Carbon Co., Inc.

## VALVES, PIPING

**113 Combination Pump Valves** — Bulletin CVP 560, 18 pp, presents engineering data on a line of combination pump valves, silent check valves and specialty items. Pictures typical installations, includes cutaway views showing component parts, and tabulates working pressures. Combination Pump Valve Co.

**114 Gate Valves** — Bulletin 561 describes gate valves for water works distribution systems. Cross sections and cutaway views illustrate construction and operation; dimensions are tabulated. Valves featured conform to American Water Works Association specifications. While these specifications cover only bell end and flanged end non-rising stem gate valves in 3- to 48-in. sizes, this bulletin also includes outside-screw-and-yoke valves conforming to such specifications, and applicable to design, working pressures. The Kennedy Valve Mfg. Co.

**115 Solenoid Operated Valves** — Bulletin W-7, on company's Cushioned solenoid operated valves, discusses their construction, operation, installation and servicing. Valve patterns available, and suggested applications for these valves are also treated. Dimensional data, parts list, electrical characteristics are included. Golden-Anderson Valve Specialty Co.

**116 PVC Valve, Fittings** — Six-pp Circular 601 describes the Luncor valve and fittings. Illustrates construction of this all-molded corrosion-resistant PVC valve; lists more than 250 reagents it resists. Also discusses advantages of the valve and includes installation data and dimensions. Lunkenheimer Co.

**117 Control Valve** — Six-pp Bulletin SK 356 features company's line of pilot operated control valves, describing operation, uses, optional features. Illustrated with photos and line drawings, bulletin includes tables which cover types of service, pressure ranges, condensed specifications. Valvair Corp.

**118 Mine Service Pipe** — This 12-pp, illustrated brochure which suggests a range of uses for this asbestos cement pipe, describes how it is made, and gives case histories of various installations. Special emphasis is placed on the Ring-Tite coupling, with diagrams and photos showing assembly. Johns-Manville.

## MECHANICAL POWER TRANSMISSION

**119 Guide to Roller Bearing** — Catalog 55, 72 pp, contains specification

data on all models of self-aligning roller bearings manufactured by the company. Describes self-aligning principle of concave rollers running between convex raceway, the Micro-Lock adjustment, and "Z" seal. Included is completely revised engineering data, new load rating tables, exploded view for parts identification. Shafer Bearing Div., Chain Belt Co.

**120 Roller Bearings** — Greater load capacity and simplified application, resulting in overall economy, are two features of company's self-aligning roller bearings described in 8-pp Book 2658. Covers adjustable single-row self-aligning roller bearings; adjustable double-row bearings; and preadjusted double-row self-aligning bearings. Also gives engineering selection information, dimensional specifications and recommended fitting practices. Link-Belt Co.

## PUMPS, PUMPING

**121 Boiler Feed Pumps** — Information on boiler-feed pumps for two-stage centrifugal types is covered in illustrated Bulletin W-318-B23P. Major features of types UNB and UB-12 with capacities to 2500 gpm and heads to 900 ft are described, along with information on elastic seal rings, casing, impellers and casing rings, shaft, shaft sleeves, and stuffing box. Dimension drawings and reference chart on suction and discharge diameters, and flange dimensions are included. Worthington Corp.

**122 Solids Handling Pumps** — Bulletin 121-A, 8 pp, describes a complete line of non-clog pumps for handling solids in suspension. Included are vertical, horizontal and close-coupled types used to handle liquid components of industrial processes, industrial waste, and for such pumping applications as water supply, drainage and sewage handling. Specifications are included. Aurora Pump Div., The New York Air Brake Co.

**123 High Temp Pumps** — Bulletin 1040 describes and illustrates construction and operation of high temperature Series T canned motor Chempumps. Full details on performance, materials of construction, dimensions, power requirements and other specifications are given. Chempump Corp.

**124 Sump Pumps** — Bulletin 103 DS describes company's packaged type DSA sump pumps with capacities to 170 gpm and heads to 70 ft. Includes cutaway drawings, performance curves, proposed specifications and typical dimensions. Aurora Pump Div. The New York Air Brake Co.

**125 Displacement Pump** — Descriptive and engineering data covering the Eco All-Chem rotary displacement pump line for corrosive and hazardous fluids is contained in Bulletin AC56. Design and applications are described, and construction and performance data, operating specifications on stock models, dimensional data, and information on component materials, drives and mounts are included. Drive combinations are illustrated. Eco Engineering Co.

## HOSE, ACCESSORIES

**127 Industrial Fire Hose** — This 4-pp illustrated data sheet reviews factors in the selection of hose for safety and long life and offers operating tips and specifications on 11 types of fire hose for industrial use. Also describes a chemical treatment for hose, called Superseal, which protects against mildew, rotting, moisture absorption and freezing. Industrial Products Div., The B. F. Goodrich Co.

**128 Hose Couplings** — Catalog 400, 28-pp, describes and illustrates the Flanco four-bolt, split-flange coupling for high, medium, low and suction return applications. Covers high pressure two wire braid pressed-on hose assemblies, suction hose, spiral wire hose assemblies, stem angles and connector units, two and one wire braid clamp-type hose assemblies, low pressure two rayon braid hose and suction hose assemblies, and split-flange clamp-type couplings. Includes photos, drawings, dimensional data, and full specifications. Anchor Coupling Co. Inc.

## MATERIALS HANDLING

**129 Belt Conveyor Carriers** — Sixteen-pp Bulletin 355 features conveyor carriers and return rollers for general service on all types of belt conveyor installations. Covers ball bearing carriers, simplex carriers, deep-trough carriers, rubber-roll impact carriers, automatic belt-training carriers, guide rollers and belt conveyor trippers. Includes application photos, drawings, tables of dimensions and other specifications. Stephens-Adamson Mfg. Co.

**130 Safe Sling Loads** — Bulletin 5308-R lists safe loads for slings of 20 sizes wire rope when used at various angles of application. Information is listed to cover slings varying from ½ ton safe load to 48.7 tons safe load. Listings should be of assistance to power engineers faced with the problem of lifting loads with overhead cranes. Macwhyte Co.

**131 Overhead Cranes** — Catalog M-100 is a 40-pp handbook covering electric overhead travelling cranes and other handling equipment. Profusely illustrated, contents include information on the latest developments in crane manufacture, classification of cranes, runways, electrical equipment and other data. Dominion Bridge Co. Ltd.

## LIGHTING

**132 Fluorescent Ballasts** — Twenty-pp Bulletin GEA 6249 on fluorescent ballasts contains descriptive information on the sound rating system, quality control, life expectancy, design features of the ballasts; also development facilities and customer services of manufacturer. Explains and illustrates why ballasts give long-run economy. General Electric Co.

**133 Industrial Lighting Units** — The 36-pp 1956 Edition of the RLM Standard Specifications for industrial lighting units contains important revisions

in specifications on both incandescent and fluorescent industrial lighting units, as well as new lighting data of special value to specifiers. Most important of the changes and additions are the new coefficient of utilization tables for eight different incandescent and fluorescent lighting units. Calculations are based on latest Zonal Method of computing coefficients of utilization and illumination on room surfaces. Also included are revised light distribution curves on RLM direct and semi-direct fluorescent lighting units. Available to qualified power engineers, please state your job title. RLM Standards Institute.

## WATER TREATING AND WASTE HANDLING

**134 Treating Plant** — Bulletin 1825, 28-pp, describes company's Accelator treating plant, covering historical development, operating features and distinguishing characteristics. Applications in water, sewage, and industrial waste problems are presented. Operating data of successful installations showing ability of Accelator plant to handle liquids of high turbidities and variable flows included. Infilco Inc.

**135 Sub-Surface Washers** — Technical Reprint T-139, 8-pp, discusses the development of the sub-surface washer, used in demineralizers, zeolite softeners and filters. Presents the causes of fouling and the problems encountered with actual installations in a variety of industries. Cutaway drawing showing features is included, along with flow sheets and a diagrammatic sketch of pilot unit observations. Graver Water Conditioning Co.

**136 Waste Treatment** — Bulletin 850-B describes the Cyclater Clarifier and contains flow diagrams and descriptions of waste treatment systems involving chemical precipitation, coagulation and sedimentation. These include wastes from metal finishing plants, oil refineries and paper mills. A companion bulletin, No. 6051, on the Sediflotor Clarifier, discusses application of flotation to industrial waste treatment. Points out applications in recovering paper mill fibers, oils, greases, and in treating wastes from paper mills, refineries, maintenance depots. Infilco Inc.

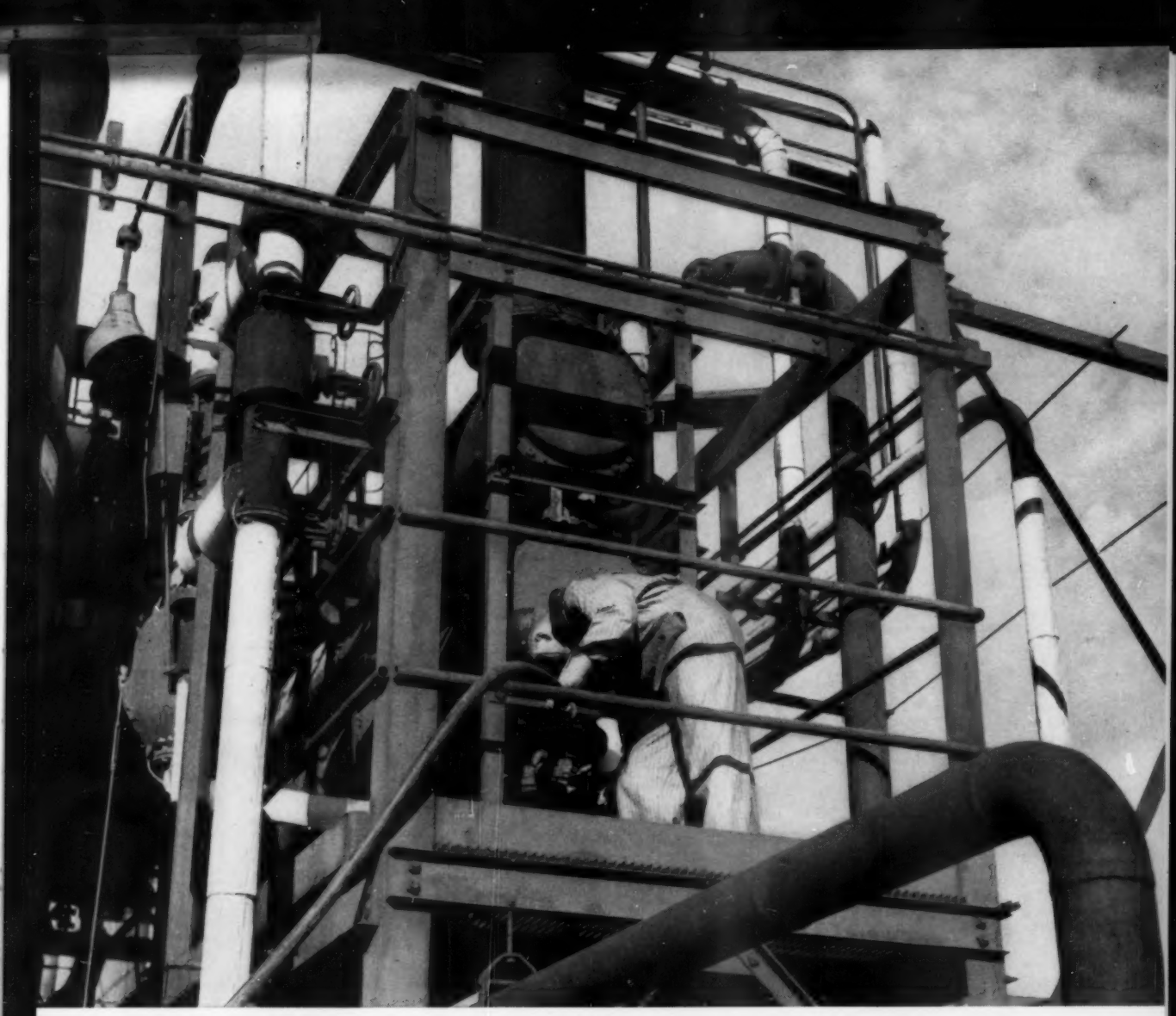
## VIBRATION CONTROL

**137 Vibration, Noise Control** — Bulletin K6A, a guide to machinery mounting, vibration and noise control, discusses such problems as: machine mobility; eliminating floor bolts, leveling machines; eliminating rejects. Shows by means of case histories how these problems are being solved by such isolation media as steel springs, cork, and rubber. An insert section features selector chart. The Korfund Co., Inc.

**138 Vibration Mountings** — "Floating Rail" vibration mountings and fan and motor bases are described in Catalog FR-55. Detailed descriptions of design features are given and include the high deflection rubber-in-shear isolators, channel supports, others. Typical installations are illustrated and schematic drawings included. Industrial Div., T. R. Finn & Co., Inc.

## INSTRUMENTS AND CONTROLS

**139 Automation Components** — Condensed Catalog D-31, 20 pp, features automation components and control systems for improving automatic operation. Some of the products covered are differential transducer control and automation systems, a complete line of time control equipment including electronic,



# There's too much at stake —clean it right

Chemical cleaning involves costly equipment and often work stoppages. It's a job for experts. Let Dowell protect that equipment and keep production losses to a minimum when you have scale or sludge problems.

In over 15 years our trained engineers have serviced virtually every kind of equipment in plants, mills and refineries throughout industry. In fact, Dowell has cleaned over 10,000 boilers alone!

This experience means lower costs to you—in more thorough work, restored efficiency and less production loss.

Furthermore, Dowell engineers know you value the safety of your men and equipment. Dowell uses only the latest safety equipment and techniques to eliminate hazards and accidents. Our engineers work closely with your safety personnel to establish the safest possible working procedures.

Call the nearest of more than 165 Dowell offices. An experienced engineer will be glad to talk over and help you with your cleaning problems any time — at no obligation. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. F-24.

***chemical cleaning service for industry***

**DOWELL**

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

For more data circle 517 on Post Card

# This
## *is what you buy...*

When you invest hundreds of thousands of dollars in a cooling tower, what you are actually buying is the tower's consistent ability to deliver *cold water* at specified temperature and volume . . . at an economical price per gpm.

And because actual performance is an "unknown" until the tower is in operation, you purchase cooling towers largely on faith in the manufacturer.

You can place your absolute confidence in The Marley Company's ability to deliver the cold water you specify. At Marley, water cooling has been an exclusive specialization—not a sideline—for 35 years. Every company facility—design, research, engineering, production—is devoted 100% to the science and techniques of water cooling. This single-minded approach to water cooling problems has resulted in Marley's undisputed leadership in the water cooling field by any standards you care to apply.

The Marley Company, however, does not ask you to buy its cooling towers on blind faith. Rather, Marley urges every industrial tower owner to test his tower and has paved the way by developing the simplest and most authoritative tower-testing procedure. And finally, every Marley cooling tower, from the moment it starts, receives the benefit of professional observation and inspection by Marley field engineers—specialists in maintaining both tower function and tower structure in excellent condition.

**The Marley Company**
Kansas City 14, Missouri

MARLEY

For more data circle 518 on Post Card

equipment operator mechanisms, valves, counters and electronic contactors. Automatic Temperature Control Co.

**140 Combustion Meters** — Catalog 56-553-1 contains photos of the different types of chemically operated $CO_2$ analyzers and recorders. Descriptions of the operation and sampling system are accompanied by drawings. Application, principle, features, available models and other data included. The Hays Corp.

**141 Meter Socket Selection** — Bulletin GEA-5878B, 20 pp, contains all the basic information on company's meter socket line, including round and square die-cast sockets for single-phase and network meters, box-type for standard polyphase, and high capacity single and polyphase meters. Photos, dimensional drawings and connection diagrams are included. General Electric Co.

**142 Measuring Equipment** — Eighty different devices are covered in 40-pp Measurement Equipment Catalog GEC-1016. Contains complete product information including applications, sources of additional information and pictures. Ranging from simple thickness gages to the mass spectrometer leak detector, there are instruments for research, production, laboratories and other use. Measurement categories include color, leak detection, insulation, and radiation monitoring. General Electric Co.

**143 Carbon Dioxide Measurement** — Technical Paper 133, 16-pp, discusses determination of $CO_2$ in water by conductivity measurements. Describes a new method developed for the determination of carbon dioxide which is applicable to analysis of waterside deposits, treatment chemicals and organic carbon in water. W.H. & L.D. Betz.

### CORROSION, RUST CONTROL

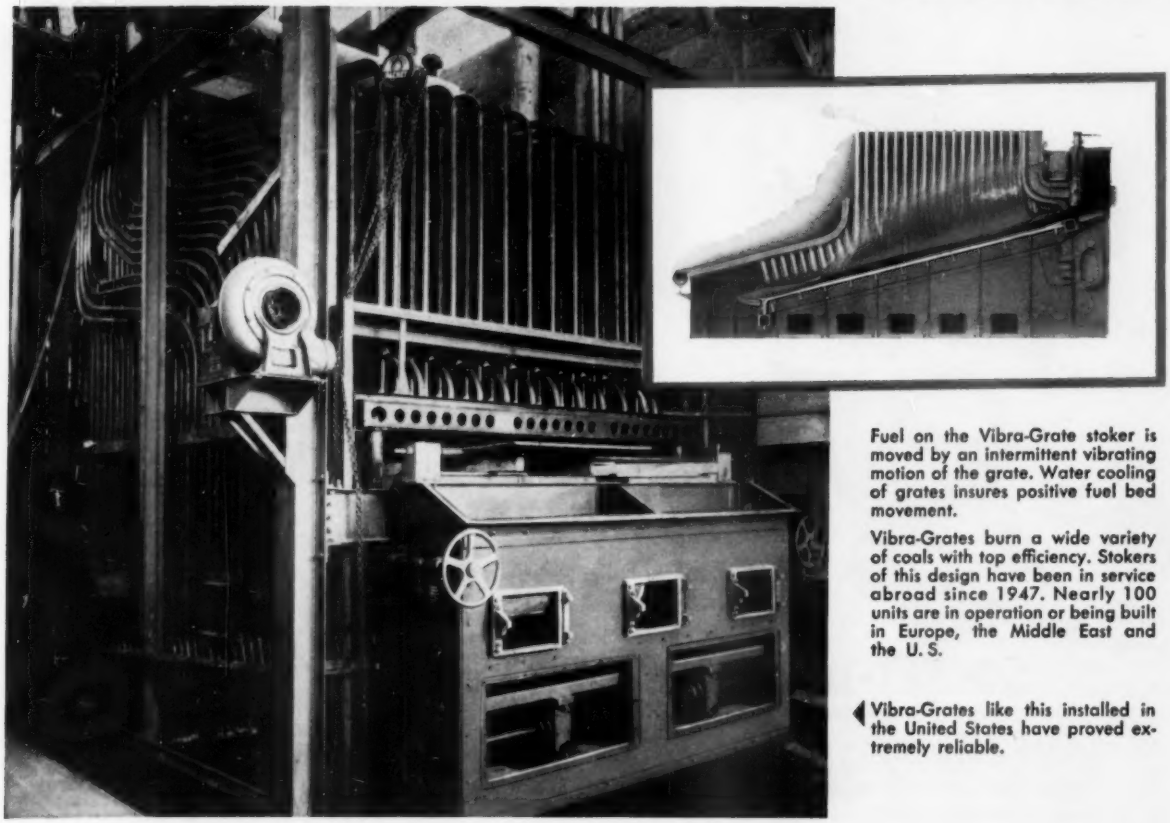
**145 For Corrosion Proofing** — Provided in this 8-pp brochure on corrosion proofing materials and techniques is detailed information on cement mortars, interliners for masonry construction and protective coatings and linings for surface treatment. Tables and charts are included for selecting proper cement mortars and determining resistance to various corrosive conditions. Selection charts are also provided. Pennsylvania Salt Mfg. Co.

You'll save time in ordering bulletins by using the Reader Service Cards on page 123. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

**146 Protective Coatings** — Facts on industrial protective coatings are presented in this 8-pp illustrated bulletin. Lists advantages and applications and shows characteristic properties. An application chart details procedures for applying the various coatings. Also included are rules for getting "better mileage" from the coatings. Nukem Products Corp.

**147 Spray Coatings** — These three data sheets feature company's line of spray coatings for industrial use. Form K-2004 describes a zinc chromate metal primer,

# NOW! TWO MORE VIBRA-GRATES ORDERED



Fuel on the Vibra-Grate stoker is moved by an intermittent vibrating motion of the grate. Water cooling of grates insures positive fuel bed movement.

Vibra-Grates burn a wide variety of coals with top efficiency. Stokers of this design have been in service abroad since 1947. Nearly 100 units are in operation or being built in Europe, the Middle East and the U. S.

◀ Vibra-Grates like this installed in the United States have proved extremely reliable.

WHEN A SOUTHERN STATE required a new stoker installation at one of its institutions, it set up certain basic requirements... great reliability ...abolition of smoke... freedom from objectionable discharge of solids from stack, all while burning local coals. Freedom from fly ash discharge was so essential, in fact, that any form of suspension or semi-suspension burning of coal was eliminated from consideration. AE water-cooled Vibra-Grate stokers were the obvious answer and two of them will be installed... *without dust collectors.*

Each Vibra-Grate stoker will have a steam generating capacity of 30,000# per hour continuously, with 35,000# peaks. The coal to be burned has the following proximate analysis: $H_2O$, 3%; V.M., 18%; F.C. 67%; ash, 12%; S., 1.5%; BTU per # A.F., 13,400. Other Vibra-Grates in the United States have been burning high volatile coals.

AE Vibra-Grate stokers are available in standard capacity ranges from 25,000 to 150,000# of steam per hour. Write for full information about Vibra-Grate, today's most efficient stoker.

## AMERICAN ENGINEERING COMPANY

DEPT. S-101, WHEATSHEAF LANE & SEPVIVA STREET, PHILADELPHIA 37, PA.

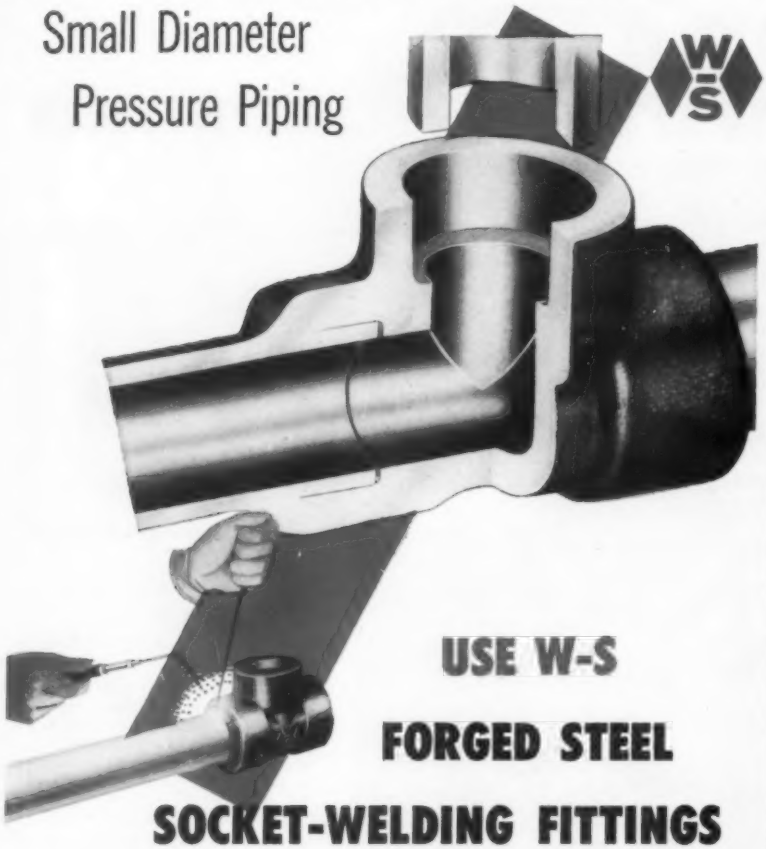
*Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P. Q.... Bawden Industries Ltd., Toronto, Ont.*

AE products are: Taylor, Perfect Spread and Vibra-Grate Stokers, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers, Marine Deck Auxiliaries.

**For more data circle 519 on Post Card**

Here's the **EASY WAY TO WELD**

Small Diameter Pressure Piping



**USE W-S FORGED STEEL SOCKET-WELDING FITTINGS**

In addition to providing high strength and toughness, W-S Forged Steel Socket-Welding Fittings are also easy to install. Deep sockets support and align the pipe for welding... eliminating the need for tack welding or special fixtures. No back-up ring is needed either. The fillet-weld is completely outside the pipe. Welding icicles just can't form inside the pipe. The result is a clean, tight welded joint that will readily resist high pressures and the stresses of shock and vibration. What's more, installation costs are lower.

W-S Socket-Welding Fittings are available in sizes ⅛" to 4" for schedule 40, 80, 160 and double-extra heavy pipe in carbon steel, stainless steels and alloy steels.

For complete information on the installation and operation advantages of W-S Forged Steel Socket-Welding Fittings, send today for Bulletin A-3-56.

**W-S FITTINGS DIVISION**

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

For more data circle 520 on Post Card


Form K-2006 gives data on a spray stencil ink; and Form K-2008 covers a corrosion prevention spray. Krylon, Inc.

**148** **Why Rubber Linings** — Described in this 8-pp bulletin are advantages and application of rubber lining to steel tanks, drums, pipes, valves, fittings and pumps. Includes tables giving corrosion resistance of company's rubber lining to inorganic acids, salts and alkalies, organic materials and many miscellaneous materials. Details on the chemical, abrasive and temperature resistant qualities of rubber linings and on the types of rubber linings available are also given. Metalweld, Inc.

**149** **Scale, Rust Removal** — This 8-pp folder on removal of rust and lime scale by simple soaking or circulating describes the action of company's Compound No. 32, an inhibited liquid descalant, which is said to eliminate mechanical scraping or rodding out. Specific instructions for simple application procedures are given. Oakite Products, Inc.

### SUPPORT SYSTEMS

**150** **Tubing Support System** — Twelve-pp Bulletin 255 describes the Instrof system for the support of instrument tubing. Stresses quick-joining and other advantages of a built-in pin-type coupler with which major units of the system are equipped. Shows how flat bends, crosses, tees, and vertical bends are made. Miscellaneous fittings are also shown. Dimensional data and load-deflection curves are provided. Instrof Inc.

**151** **Cable Troughs** — This 12-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and many special fastening devices to save time and labor. Contains full instructions for installations, load charts, accessory items, some typical installations and full list of distributors. The Globe Co.

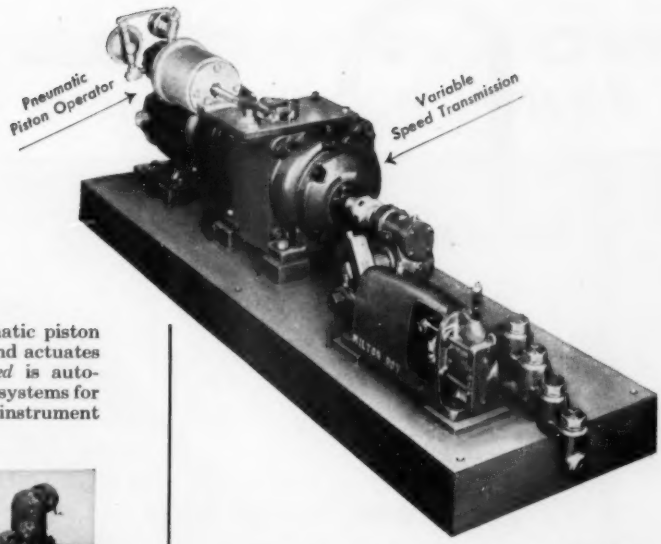
### BOILERS, HEAT EXCHANGERS

**152** **Heating Boilers** — Catalog AP-237-F, 44 pp, describes and illustrates company's steel boilers for heating commercial, industrial and other buildings. Presents ratings and capacities plus dimensions and engineering data. (For quick reference, brief descriptions of boiler types, firing method and capacities are printed at top, outside corners of pages.) Among boilers pictured are those with low water lines for limited headroom installation. Also covered are indirect hot water heating coils, hot water supply and storage tanks and induced draft fans. Pacific Steel Boiler Div., National-U.S. Radiator Corp.

**153** **Heat Exchanger** — Bulletin 1401, 20-pp, describes an extended surface design of heat exchanger with longitudinally finned tubes known as the G-R Twin G-Fin Section. Explains in detail distinctive features of design, outlines various applications, illustrates typical installation , quotes several field service reports, and includes specifications, dimensions. The Griscom-Russell Co.

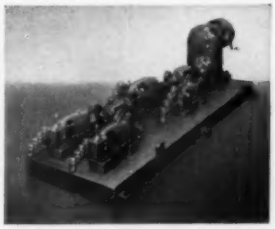
### OTHER EQUIPMENT

**154** **Axial Fans** — Bulletin B-1013, 36-pp, describes Series 203 axial fans for

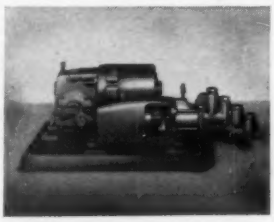



In this Controlled Volume Pump, a pneumatic piston operator receives an instrument air signal and actuates a variable speed transmission. Pump *speed* is automatically adjusted to process demand. Servo systems for automatic adjustment of stroke *length* by instrument air signal also available.

This pump is a 4-cylinder formulating unit. All liquid ends are powered by a variable speed drive, manually adjustable. Stroke length of each liquid end is individually adjustable, manually.



Standard motor-driven, simplex-controlled volume pump, with constant speed motor and manual adjustment of stroke length.



This formulating pump has two "miniPumps" (capacities in milliliters per hour) and one standard motor-driven pump, all powered by one constant speed drive. Stroke length of each unit is manually adjustable while pump is in operation.

## Which pump is best for YOU?

*Write today for application data on Controlled Volume Pumps in:*

Paper Making (Bulletin 455)
Industrial Water Treating (Bulletin 953)
Process Instrumentation (Bulletin 1253)

# Broad flexibility for metering process additives

If you pump and meter chemicals against a head . . . or maintain fixed ratios of two or more chemical streams . . . or automatically regulate flow of a control agent in a control system, such as pH, there's a Milton Roy Controlled Volume Pump that's exactly *right* for your application.

Illustrated are a few of many flexible adaptations in simplex, duplex and formulating pump designs that are available from Milton Roy, with manual or automatic adjustments of stroking length or speed. Capacities range from 3 milliliters per hour to 45 gpm, pressures up to 50,000 psi. Accuracy of delivery is within plus or minus one percent. Liquid ends are furnished in a wide selection of alloys and in plastic. Sanitary design, too.

Have you investigated how you can reduce chemical costs and upgrade product quality by using controlled volume pumps? One of the bulletins listed probably contains the economical answer to your chemical metering problem. Milton Roy Company, Manufacturing Engineers, 1300 East Mermaid Lane, Philadelphia 18, Pa.

milton Roy
CHEMICAL FEED SYSTEMS

*Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.*

**For more data circle 521 on Post Card**

# if

## you have any of these troubles:

- scale, corrosion, or foaming in your **boiler operation**
- rust and corrosion in your **steam and condensate return lines**
- scale, corrosion, or algae growth in your **cooling or condenser water system**
- corrosion or scale in your **hot or cold water tank and lines**
- rust and corrosion in your **brine or sweet water system**
- scaled up **pumps, water jackets, compressors, coils, lines, or equipment**
- sludge and moisture in your **fuel oil supply**
- soot deposits in your **furnace combustion areas**

# then . . .

**let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam, and fuel. Mail the coupon today for full information.**

*65 Years Experience in the Chemical Treatment of Water.*

**Chemical Treatment for Water Steam and Fuel**

**WESTERN CHEMICAL COMPANY**

**717 Washington Street Kansas City 5, Missouri**

**MAIL THIS COUPON TODAY**

Please send information about

Name

Firm

Address

City Zone State

**For more data circle 522 on Post Card**


ventilation, process air supply and process air recirculation applications. Tubeaxial and vaneaxial flow principles are described and illustrated. Design and construction features as well as specific recommended applications are discussed, and photos are included. Selection tables and installation drawings giving detailed dimensions are given, along with shipping weights, friction and duct sizing charts, and conversion chart. American Blower Corp.

**155 Sectional Condenser** — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

**156 Inert Gas Generators** — Bulletin IGG-155, 10-pp, describes inert gas generators for protection against fire and explosion. In addition to detailed drawings, photos, capacity and dimension tables, book contains a useful information sheet. Includes an analysis of the work to be done by generators, operaing conditions, utilities needed and other data needed for selection. Roots-Connersville Blower Div., Dresser Industries, Inc.

**158 Dust Collectors** — Manufacturer's full line of cabinet cloth filter and cyclone separator type dust collectors is pictured and described in 16-pp Catalog 39. Tells why dust collectors are essential to industry, how unitized collectors save money and how they can be used. Also includes list of operating and construction

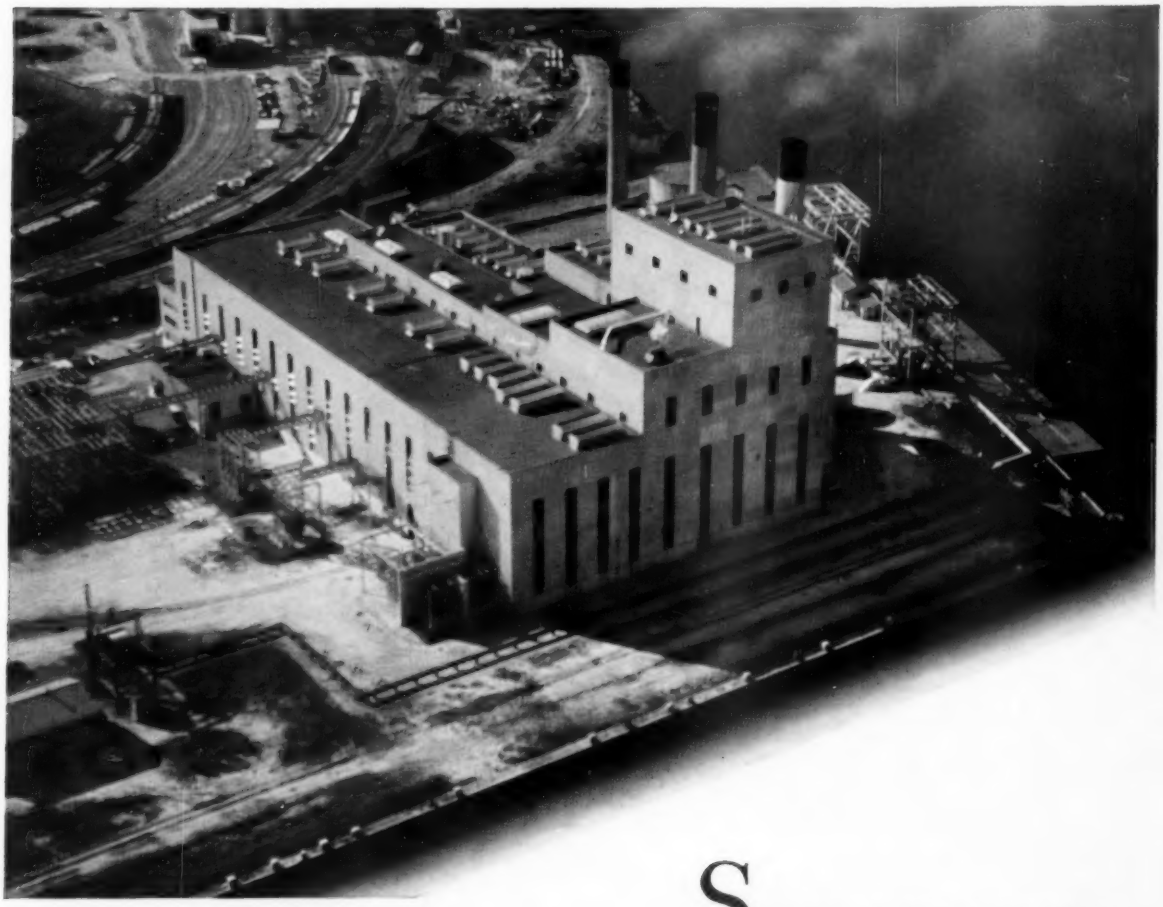
features, details of each model, accessories, optional equipment, selection information, specifications and descriptions of such applied products as exhausters and blowers. Torit Mfg. Co.

**159 Improved Crushers** — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

**163 Auxiliary Coal Equipment** — Bulletin 855, 54-pp, itemizes a complete line of auxiliary equipment for coal handling which includes bearings, take-ups, holdbacks, chain, screen plates, pumps and valves. Also included is specification information on conveyor and drive pulleys, V-belt sheaves, sprockets, gears, shafts and keys. Descriptions are supplemented with photos, dimension drawings, data tables and specifications. McNally Pittsburg Mfg. Corp.

**164 Germanium Rectifiers** — Bulletin GER-1204, 10-pp, gives general information on industrial uses of germanium rectifiers, including characteristics, construction, advantages, and design and application considerations. Typical installations are listed and several types are pictured. General Electric Co.

# MEETING TAMPA'S DEMAND FOR POWER



*The new 66,000 kilowatt unit at Hookers Point includes the first large pressurized furnace boiler installation in this country. Steam is delivered at 1250 psi and 950° F.*

Since the end of World War II, the demand for electric power in Tampa, Florida, has increased nearly 500 per cent. To keep pace with this phenomenal load growth, Tampa Electric Company recently completed a 66,000 kilowatt addition to its Hookers Point Power Station.

The initial installation at Hookers Point in 1948 consisted of a single unit of 30,000 kilowatts. In 1950 two additional units of similar capacity were installed, and in 1952 a fourth unit of 44,000 kilowatts was added.

With the completion of the new unit in 1955, the total capability of Hookers Point is now approximately 240,000 kilowatts.

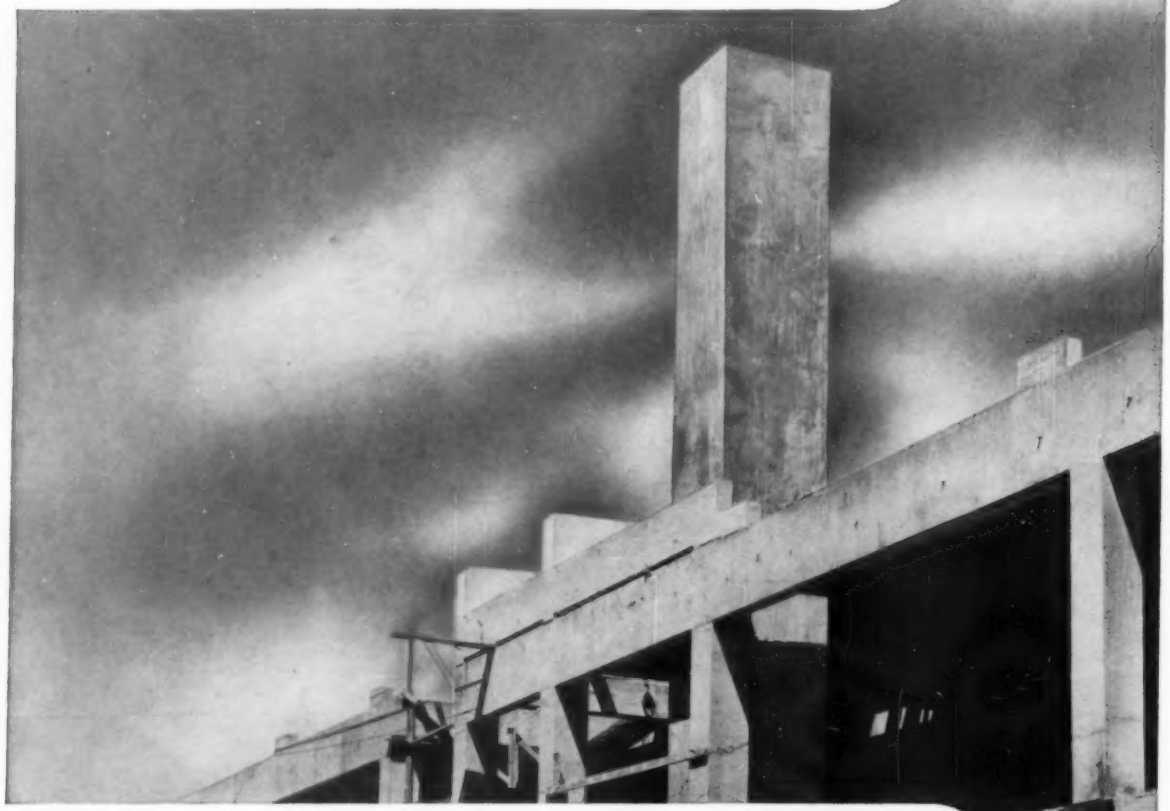
Design and construction of the entire station was by Stone & Webster Engineering Corporation.

## STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY of STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

**PROBLEM:** How to build a chimney to serve both boiler and incinerator



**ANSWER:**

## Make it with **LUMNITE*** Heat-Resistant Concrete

High chimney temperatures, and location of this one inside the building, called for refractory concrete which insulates as well as resists high temperatures.

Refractory concrete made with Lumnite* cement was chosen. Concrete construction saved weight, permitting smaller foundation footing. The job was placed with ordinary labor, and, in addition, its smoother surface gives better draft.

Similar installations have been in service for several years. Plants also use Lumnite calcium-aluminate cement for lining steel stacks, flues and ducts, precipitators, boiler walls, ash pits and hoppers – in fact, wherever heat, mild corrosion and abrasion are encountered.

So keep a supply of Lumnite cement on hand. And, for added convenience, use a packaged castable mix containing Lumnite cement and selected aggregates for a wide variety of applications. Castables are made and distributed by leading manufacturers of refractories. For full information, write:

L-125

**UNIVERSAL ATLAS CEMENT COMPANY**

UNITED STATES STEEL CORPORATION SUBSIDIARY

100 PARK AVENUE, NEW YORK 17, N. Y.

*Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee*
*Minneapolis • New York • Philadelphia • Pittsburgh • St. Louis • Waco*

*"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

**Atlas® Lumnite Cement**

**FOR INDUSTRIAL CONCRETES**

REFRACTORY • INSULATING • OVERNIGHT • CORROSION-RESISTANT

United States Steel Hour—Televised on alternate Wednesdays—See your local newspaper for time and station.

**For more data circle 524 on Post Card**

Can I use this sheet packing on hot oil lines, too?
Sure J-M Service Sheet is equally good for oil, steam and gas lines!
Johns-Manville

**Your J-M Packings Distributor can tell you why this quality sheet packing has maintained such an excellent reputation for over 35 years**

**Where it's used:** Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

**What its advantages are:** J-M Service Sheet is a quality packing, made of selected long-fibre asbestos bonded with heat-resisting compounds. It is graphited on one side to permit breaking a joint without destroying the gasket. The ungraphited side is ruled into one-inch squares to speed cutting and reduce waste. And . . . you can order it in large economical quantities because J-M Service Sheet will not dry out in stock!

**How it is furnished:** Service Sheet is supplied in sheets 54″ x 63″, 36″ x 126″, 36″ x 63″, and 54″ x 126″ sheets in thicknesses of 1/64″ to ¼″ and 108″ x 126″ sheets in thicknesses of 1/32″ to ¼″. It is also furnished as cut gaskets in standard and special shapes. See the J-M catalog for further details.

**Your J-M Packings Distributor** carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

**Johns-Manville PACKINGS & GASKETS**

For more data circle 525 on Post Card

# the Miracle on

On the banks of the Ohio, right now, these two huge electric plants are turning out power at the rate of over 18-billion kilowatt-hours annually. They are, respectively, the first and second largest investor-owned power plants in the world.

They stand on what was farmland less than three and one-half years ago.

Their completion, substantially ahead of schedule, is the result of the outstanding teamwork of management, investors, engineers, technicians and workers in privately-owned utilities and their suppliers.

The vast power output of these plants, *almost half as much electricity as all France produces*, is ready to assure uninterrupted operation of the Atomic Energy Commission's uranium diffusion center near Portsmouth, Ohio.

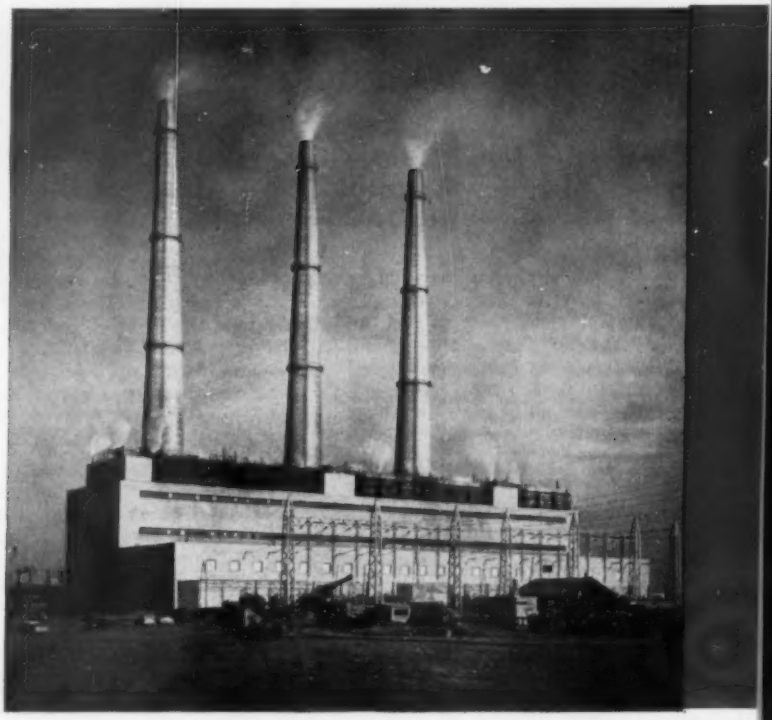
When the AEC made its enormous needs known, 15 private electric companies* joined forces to form the Ohio Valley Electric Corporation and its subsidiary, Indiana-Kentucky Electric Corporation. Pooling their resources in men, money and experience, they and their suppliers worked faster than the construction timetable. In quick order the 11 gigantic B&W boilers, the turbines, generators, buildings—and all the vast complex of auxiliary equipment—were designed, built and placed into operation.

The first generating units were placed in commercial operation in February 1955. The final unit went on the line in February 1956 at Clifty Creek, marking the largest installation of power in a single project ever made in a twelve-month period.

All Americans can be proud of OVEC-IKEC for this great accomplishment. What appears to be a miracle, in reality is, a clear demonstration of what private enterprise and enlightened government, working together, can accomplish for the benefit of the entire nation.

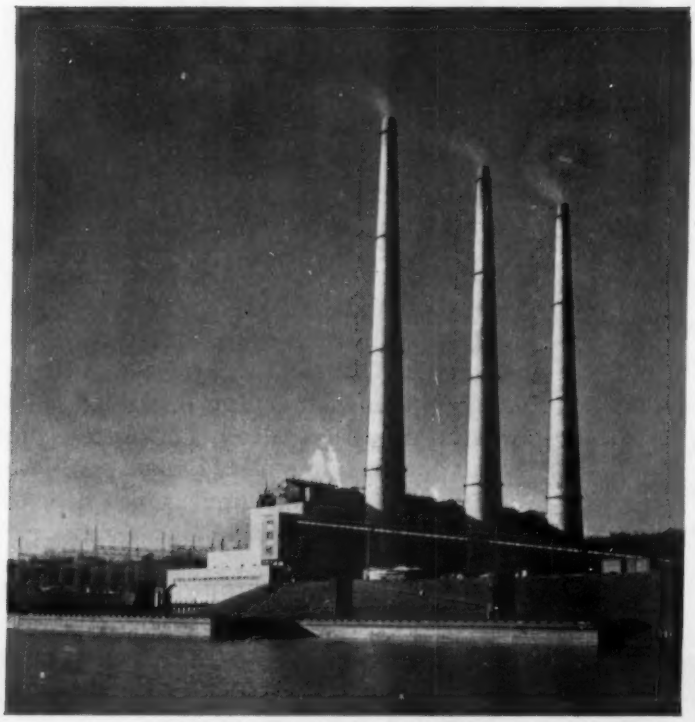
The future will undoubtedly pose many similar challenges. Can they be met? Are enough young engineers, business men, technicians, and skilled workers being developed to accept these great responsibilities? Babcock & Wilcox, like so many other American firms, is pledging its resources to guarantee that the answer will be "Yes!" Recruiting and training young men, expanding and modernizing production facilities, conducting extensive research and engineering development projects—all are part of a long range B&W program to contribute its share to the technical and economic progress so necessary for the continued growth of the nation.

The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

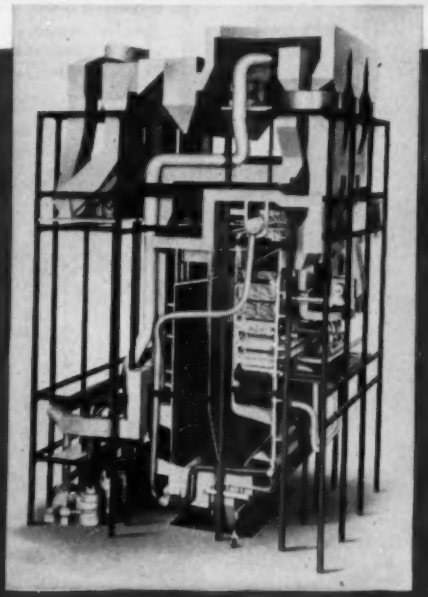


**KYGER CREEK PLANT**, at Cheshire, Ohio, with a capacity of 1,075,000 kilowatts, is the world's second largest investor-owned power plant.

# the Ohio River



**CLIFTY CREEK PLANT,** at Madison, Indiana, with a capacity of 1,290,000 kilowatts, is the world's largest investor-owned power plant.



11 B&W Open-Pass Boilers generate steam for the two plants. Each boiler produces 1,330,000 lb of steam per hr at 2000 psi and 1050 F, with reheat to 1050 F. The utilization of high temperatures, high pressures and reheat at both plants places them among the most efficient and economical in operation.

***SPONSORING COMPANIES OF OVEC-IKEC***

* Subsidiary of American Gas and Electric Co.
** Subsidiary of The West Penn Electric Co.
*** Subsidiary of Ohio Edison Co.

**BABCOCK & WILCOX**

BOILER DIVISION

For more data circle 526 on Post Card

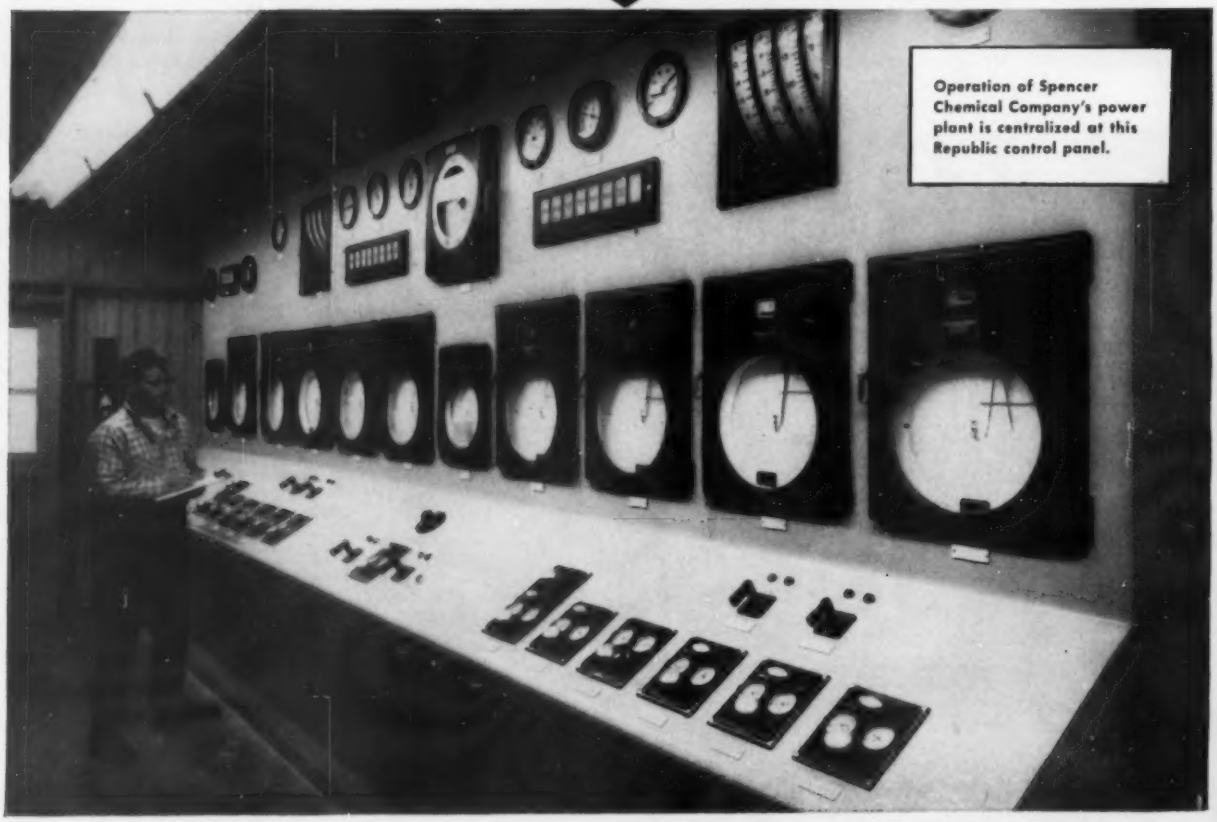
# Automatically Controls Outdoor Steam Plant

## FOR FAST LOAD CHANGES

**REPUBLIC Combustion Control System at New Texas Chemical Plant Automatically Prevents Flame-Outs and Over-Firing on Wide Load Swings, Enables Boilers to Meet Sudden Steam Demands Smoothly and Safely**

Extremely large and fast load changes make combustion efficiency only part of the combustion control job at Spencer Chemical Company's new Orange Texas polyethylene plant. The control system operates two gas fired 60,000 lbs. per hour boilers in the plant for fast response to load changes without over-firing or losing ignition on wide load swings.

To prevent over-firing when there is a sudden demand for more steam, a gas



Operation of Spencer Chemical Company's power plant is centralized at this Republic control panel.

safety regulator keeps the fuel valve in step as draft fans increase speed. By compensating for the unequal speed of response of the two boiler auxiliaries, the control system maintains proper conditions *even while loads are changing.* If steam demand falls below minimum steam conditions, a minimum gas pressure is maintained automatically at the burners, regardless of the number in service, to prevent flame-outs. In addition to safer operation, these features also mean continuous combustion efficiency for extra fuel savings.

When your problem is combustion control—for a small power plant or a central station—it will pay you to contact Republic. At your service is an experienced engineering staff that can design the control system that exactly meets your needs—specialized as they may be. This combination of expert design and modern Republic equipment can assure you of dependable, efficient control of your power plant.

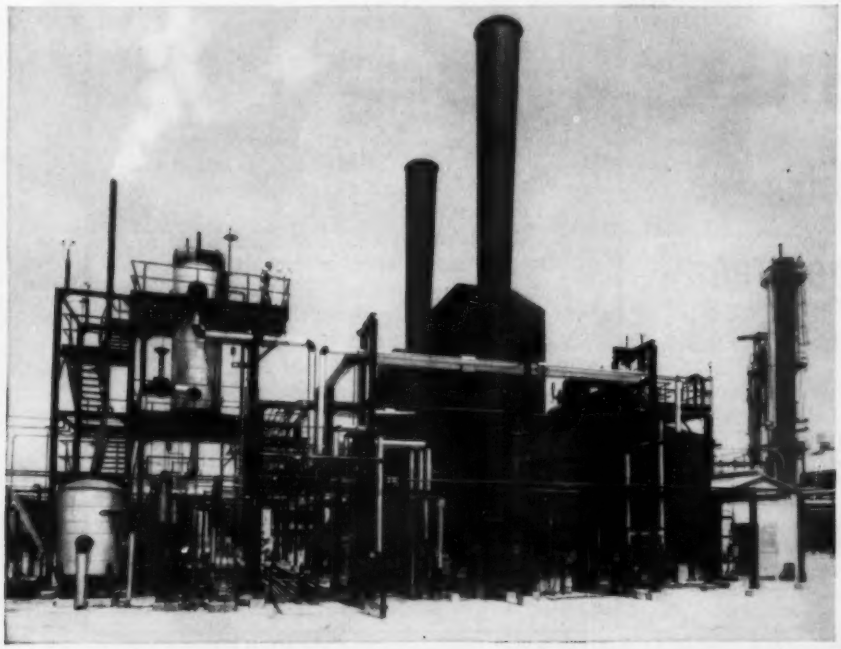
**REPUBLIC**

**Automatic COMBUSTION CONTROLS**

(pneumatic or electronic)

- ★ **FOR ALL SIZES AND TYPES OF BOILERS**
- ★ **FOR ALL LOAD CONDITIONS**
- ★ **FOR ALL METHODS OF FUEL FIRING**
- ★ **FOR ANY ARRANGEMENT OF DRAFT**

**Write for details**

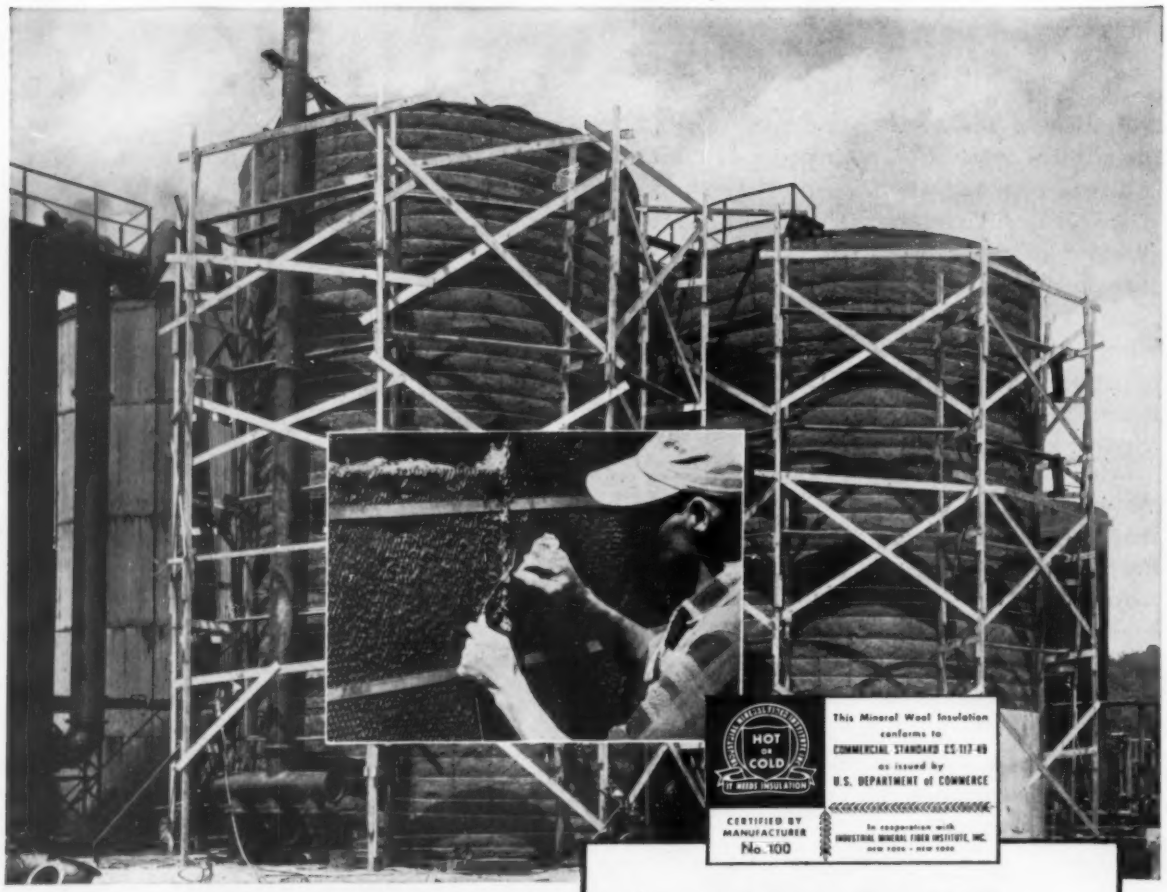


**THE ENTIRE POWER PLANT,**

except for the control panel is outdoors. Panel board is housed in sheet metal building at right. The two 60,000 lbs. per hour gas fired boilers, operating at 415 psi and 750°F., furnish steam to compressors used in converting ethylene gas into polyethylene. This is new miracle plastic that is used for products ranging from "squeeze" bottles to electrical insulation.

**REPUBLIC FLOW METERS CO.** ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

**For more data circle 527 on Post Card**




# BALDWIN-HILL *Spun Mineral Wool* BLANKETS

## the logical choice for insulating large areas *Easily Quickly Permanently*

- Large, easy-to-handle B-H insulating Blankets are made of spun mineral wool fibers felted between different types of metal fabrics.
- Their flexibility facilitates application to large or small curved or irregular surfaces.
- Resistant to moisture or corrosive fumes; will withstand normal vibration without breaking down.
- Fibers of one blanket interlock with adjacent blankets, completely enveloping equipment without breaks or joints; effective up to 1200° F.

See our catalog in Sweet's Plant Engineering File or write for a copy.

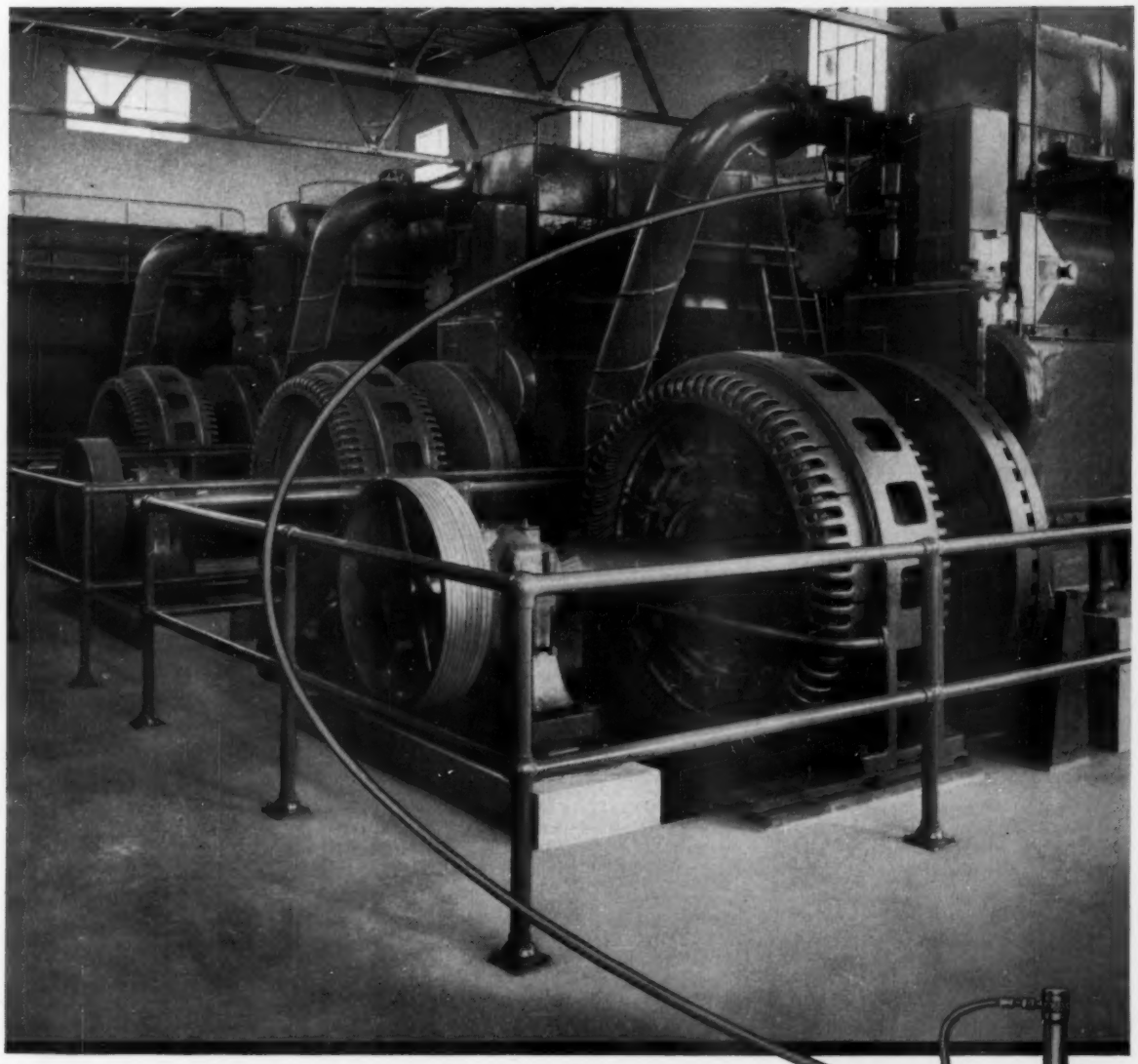
**BALDWIN-HILL COMPANY**
**206 Breunig Avenue Trenton 2, N. J.**
Huntington, Ind. Kalamazoo, Mich. Temple, Tex.

BALDWIN-HILL BH INSULATIONS

**COMPLETE LINE OF BALDWIN-HILL INSULATING PRODUCTS**

| | | |
|---|---|---|
| B-H Mono-Block | B-H Super Powerhouse Cement | B-H No. 100 Pipe Insulation |
| B-H Blanket | B-H No. 1 Insulating Cement | B-H 85% Magnesia Pipe Insulation |
| B-H Koldboard | B-H No. 52 Asbestos Cement | B-H Calcium Silicate Pipe Insulation |
| B-H Bond-Tite | B-H Spun Felt Insulation | B-H Mono-Kover Pipe Insulation |
| B-H Weatherseal | B-H Fine-Fyber Felt Insulation | B-H Spun Mineral Wool Fill |

For more data circle 528 on Post Card



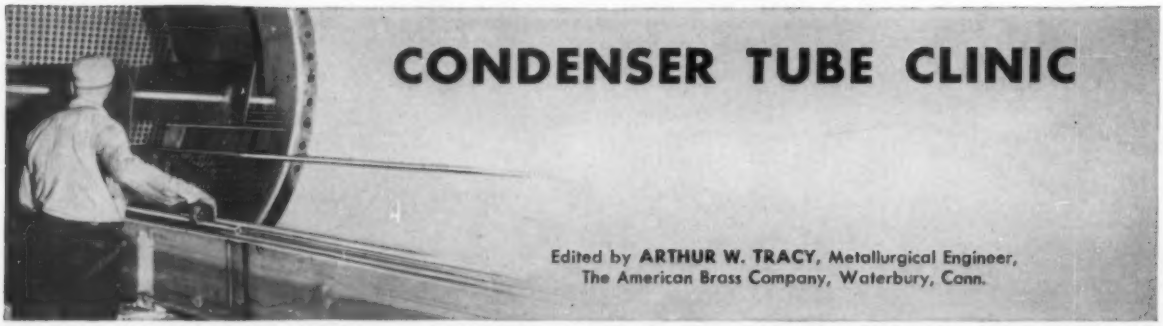
# NO STUCK RINGS!

Stop the formation of varnish, sludge and carbon in your Diesels and *keep it stopped* with Sinclair RUBILENE®, the high viscosity index oils proved by over 35 years in industrial Diesel applications. RUBILENE earns its reputation by its performance under continuous operation and heavier loads. It fights deposits and gives better protection to cylinders, pistons, rings and other vital moving parts. Your Diesel stays on the job longer . . . service time is cut 'way 'way down!

Let RUBILENE help solve your lubrication problems. Regardless of the make or age of your Diesel, where a high VI oil is needed, there's a member of Sinclair's RUBILENE or RUBILENE HD family that meets your requirements exactly. Call your local Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Ave., New York 20, N. Y. *There's no obligation.*

**SINCLAIR RUBILENE OILS**

For more data circle 529 on Post Card



# CONDENSER TUBE CLINIC

Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

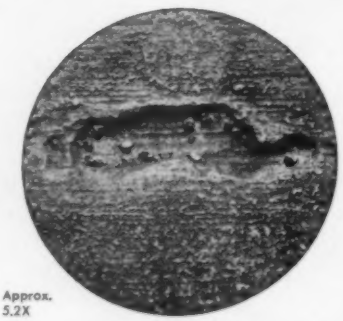
# Choose the right alloy for your condenser tubes

LONG condenser tube life depends on the proper choice of alloy as well as conditions of operation.

Fresh inland cooling water normally does not cause corrosion problems; either ANACONDA Arsenical Admiralty-439 or ANACONDA Phosphorized Arsenical Copper-108 tubes will give long service. ANACONDA Ambronze-421 tubes have been found more durable for river waters polluted with acid coal-mine drainage.

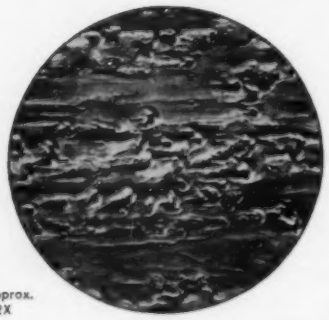
Sea water is usually more corrosive than fresh water. Clean sea water flowing turbulently, especially when air bubbles are present, causes inlet-end impingement pitting. Lowering the velocity, with subsequent smoother water flow, will solve this problem; but such a solution is not always economically feasible. ANACONDA Ambraloy-927 tubes are definitely more resistant to impingement corrosion than are admiralty metal tubes. Where water velocities are relatively high, ANACONDA Cupro Nickel, 10%-755 tubes can be expected to give even better service. ANACONDA Cupro Nickel, 30%-702 tubes are considered for the highest water velocities normally encountered in exhaust condensers.

Sea water in harbors and at river inlets is often polluted with decomposing organic matter which may settle in condenser tubes and cause deposit pitting. Hydrogen sulfide, a product of the decomposition, is also an important factor in corrosion by polluted waters because poorly protective scales containing metallic sulfides are formed. Chlorinating polluted waters is helpful in preventing deposit attack. Frequent removal of debris by brushing is an important factor in increasing tube life. Ambraloy-927 tubes generally give long service handling polluted sea water. In some cases, either Cupro Nickel, 10%-755 or Cupro Nickel, 30%-702 have served best because they are more resistant to deposit pitting.



Approx. 5.2X

**DEPOSIT PITTING** in uninhibited Admiralty Metal tube from a tidewater power station condenser. In this case a deposit of paper pulp is believed to have shielded a small area, forming an oxygen-concentration cell. The shielded area—low in oxygen content—is anodic and corrodes. Surrounding areas in contact with the solution high in oxygen form the cathode. Since the potential between the two areas is quite small, deposit pitting is usually a slow process.



Approx. 3.2X

**IMPINGEMENT PITTING** in an Admiralty Metal tube from the main condenser of an oil tanker. Excessively high water velocity caused turbulence, which carries away metal ions so that a protective film cannot form. An ion-concentration cell is formed, with the low-ion impinged area anodic; the areas where streamline, undisturbed flow persists, being cathodic. Air bubbles, water velocity, hydrostatic pressure drops in the tube, and alloy content, are all factors in this problem.

**Some ANACONDA Condenser Tube alloys especially resistant to pitting, and their nominal compositions**

| | Arsenical Admiralty -439 | Ambraloy -927 | Ambronze -421 | Cupro Nickel, 10% -755 | Cupro Nickel, 30% -702 |
|---|---|---|---|---|---|
| Copper, % | 71 | 77 | 88 | 88.35 | 68.90 |
| Nickel, % | — | — | — | 10 | 30 |
| Zinc, % | 27.96 | 20.96 | 10 | — | — |
| Aluminum, % | — | 2 | — | — | — |
| Tin, % | 1 | — | 2 | — | — |
| Arsenic, % | 0.04 | 0.04 | — | — | — |
| Iron, % | — | — | — | 1.25 | 0.50 |
| Manganese, % | — | — | — | 0.40 | 0.60 |

**TECHNICAL ASSISTANCE**—Your tube problem may require special consideration and analysis. We are always ready to help with such problems and advise in the selection of the right alloy to give the best service. Write for the new edition of our Publication B-2 on "Anaconda Tubes and Plates for Condensers and Heat Exchangers." The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5677

**ANACONDA®**
**Tubes and Plates for Condensers and Heat Exchangers**

For more data circle 530 on Post Card

# When the pressure is on

As a final step in the manufacture of Powell Valves, every valve is subjected to an *actual line test*—a *positive method* of testing. For special services, valves can be given hydrostatic, air and gas tests so that they will meet various fluid control services.

Thus, when the pressure is on *you*—when you have a production schedule that must be met—that's when you'll be glad you installed Powell Valves.

No matter what your flow control problem may be, Powell has valves designed to solve your problem. And you can *depend* on long, trouble-free service. Through careful quality control, *every* Powell Valve has PERFORMANCE VERIFIED.

Because of Powell's painstaking quality control, plant shutdown through valve failure is greatly reduced. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our *complete quality line* which has *Performance Verified.*

**The Wm. Powell Company**
**Cincinnati 22, Ohio**
**. . . 110th YEAR**

PERFORMANCE
PV
VERIFIED

*Bronze, Iron, Steel and Corrosion-Resistant Valves*

FIG. 3061-WE—300-Pound Steel Swing Check Valve

FIG. 19003—900-Pound Steel Pressure Seal Gate Valve

FIG. 1314-A—1500-Pound Integral Bonnet Steel "Y" Valve

# POWELL VALVES

**For more data circle 531 on Post Card**

# CONSTRUCTION NEWS

**Jacksonville, Fla.** — The City of Jacksonville, has plans maturing for proposed improvements to municipal electric generating plant to increase capacity. A contract in the amount of more than $1,200,000 has been awarded to the General Electric Co., contingent on the financing of revenue certificates in the amount of $22,000,000. City Utilities Commissioner plans to finance $14,000,000 revenue certificates in July of this year with the additional amount of $8,000,000 to be sold at a later date.

**Savannah, Ga.** — The Savannah Electric & Power Co., has plans under consideration for the construction of a new steam electric generator at Port Wentworth, where site has recently been acquired. New unit will be of 50,000-kw capacity and will raise company's total capacity to 173,000 kw when placed in operation in the spring of 1958. New installation will represent an investment in excess of $10,000,000. Company's construction budget of $6,300,000, includes funds for its new 40,000 kw. steam electric generator to be placed in operation in July of this year.

**Peoria, Ill.** — The Central Illinois Light Co., has arranged an expansion and new construction program between now and 1958 and plans to spend in excess of $42,000,000, during that period: $16,000,000 will be expended on new generating facilities, $12,450,000 for additions to distribution system, $4,700,000 for additions to transmission lines, $7,350,000 for gas distribution expansion and the balance of $2,000,000 on other operational facilities. Major part of new funds will go toward installation now under way of 100,000-kw steam electric generating unit at company's R. S. Wallace generating plant to be completed in the fall of 1957.

**Indianapolis, Ind.** — The Indianapolis Power & Light Co., has authorized plans for addition to local Harding Street Power Plant. Proposed steam-electric generating unit to be installed, will have a capacity of 105,000-kw and is scheduled for completion in 1958. Cost of the new unit will approximate $15,000,000, part of the utilities $57,000,000 expansion program to be completed by the end of 1958. When new unit is placed in service total capacity of Harding St. station will be 265,000-kw.

**Detroit, Mich.** — The Detroit Edison Co., has plans under way for addition to St. Clair Power Plant, with installation of number five steam-turbine generating unit. Land for the expansion has already been acquired and preparation of site for new installation is well advanced. Construction of new unit of 325,000-kw capacity will increase generating capacity of power station to 965,000 kilowatts. Work is scheduled to begin shortly for completion early in 1958. Cost of installation not announced.

**Escanaba, Mich.** — The City of Escanaba, has plans under way for expansion and additions to city's municipal power plant, to include installation of new steam generator, turbine, condenser, deaerator and boiler feed pumps. Cost of improvements and additions reported to be $6,000,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

**Minneapolis, Minn.** — The Northern States Power Co., has authorized plans for the expenditure of approximately $117,000,000, for construction expansion and modernization for the next three years. Construction budget provides for an expenditure of about $40,000,000, this year, $39,000,000, in 1957 and $38,000,000 in 1958. Part of this year's expenditure provides for a new 100,000-kw steam electric generating unit to be placed in service later this year at company's High Bridge plant at St. Paul, which will boost company's generating capacity to a total of 1,500,000 kilowatts.

**Kansas City, Mo.** — The Kansas City Power & Light Co., has authorized a cumulative preferred stock issue in the amount of $12,000,000, proceeds of which will be used in connection with expansion plans for 1956. Work will include property additions, general improvements, increased generating facilities, transmission lines and other work.

**Omaha, Nebr.** — The Omaha Public Power District, 803 Electric Bldg., has arranged for financing of a $15,000,000 bond issue, proceeds to be used in part for the construction of a new 100,000-kw steam turbine generator unit and accessory equipment at North Omaha Station, where foundations for the installation are already under way. Pioneer Service and Engineering Co., 231 So. La Salle St., Chicago, Ill., are engineers. Contract for furnishing and installing new unit will exceed $3,000,000.

**Badin, N. C.** — The Carolina Aluminum Co., has applied to the Federal Power Commission for a license to construct a hydroelectric project on the Yadkin River, in North Carolina. Cost of installation would approximate $13,800,000. Project calls for a new dam eight miles upstream from Badin, with a powerhouse installation of three 18,300-kw generating units.

**Charlotte, N. C.** — The Duke Power Co., has arranged for company financing of $39,000,000, proceeds of which will be used for major company expansion for increased generating facilities, additions and extensions to power substations, transmission lines and other work. Company estimates expenditures for 1956 and 1957 to approximate $99,000,000.

**Buffalo, N. Y.** — The Niagara Mohawk Power Co., 535 Washington St., Buffalo, N. Y., has announced a major expansion program of facilities at Gardenville switching station.

**Pittsburgh, Pa.** — The Duquesne Light Co., has announced plans for company expansion in the amount of $78,000,000 on new construction through 1958. Plans call for expenditure of $28,000,000 in 1956 and approximately $25,000,000 in both 1957 and 1958. New distribution and transmission lines are planned to service 7,700 new customers acquired since 1951 but the most costly project will be the construction of company's new 150,000 kw steam electric generating unit on which preliminary engineering has begun. Site for new installation has not as yet been announced.

**Columbia, S. C.** — The South Carolina Electric & Gas Co., has announced a construction budget for the years of 1956, 1957 and 1958 in the amount of $78,378,000. Largest single outlay in proposed budget will be the installation of a high pressure steam-electric generating station, near company's Saluda hydroelectric project. New generator expected to be completed in late 1958, will have a capacity of 137,000-kw. Completed plant will represent an investment of better than $35,000,000. Company has under consideration a unit of similar size to be installed at a later date.

**Memphis, Tenn.** — The Memphis Light, Gas and Water Commission of the City of Memphis, has completed plans for the financing of the city's new steam electric generating plant, now under construction, and revenue bond issue of $135,000,000, is expected to be completed by mid-year. As previously announced in these columns, contracts for boiler and generating installations have already been let to Babcock & Wilcox Co., New York, N. Y., and Westinghouse Electric Corp., Pittsburgh, Pa.

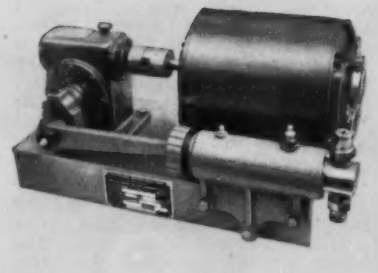
**Beaumont, Tex.** — The Gulf States Utilities Co., 362 Liberty Ave., has authorized plans for the construction of a new 22,000-kw electric power generating station, near Scott, La. New station will consists of two 11,000-kw power units, the first to be completed in the spring of 1958 and the second about a year later. Estimated cost of the two installations, with auxiliary transmission lines will approach an expenditure of $34,000,000. Upon completion of company's two unit installation now under construction near Beaumont, Tex., productive capacity will be increased by 444,000 kilowatts or about 50%.

**El Paso, Tex.** — The El Paso Electric Co., has announced a major expansion and improvement program of company's facilities through 1956. A budget of $17,538,000, has been set aside for new construction. Sum includes $2,854,000 for a new 44,000 kw turbo generator and boiler at a total cost of $6,400,000 when completed in June 1957, $500,000 toward another 44,000 kw generator scheduled for operation in 1958, $860,000 for erecting a 66 kilovolt transmission line and substation, $1,645,000 for distribution facilities and $132,000 for other miscellaneous items.

**Houston, Tex.** — The Houston Lighting & Power Co., has announced plans for construction expenditures totaling $230,000,000, for the five-year period to and including 1960. Upon completion of presently scheduled electrical generating units in 1958, company's total generating capacity will approach 1,750,000 kilowatts. Growth of area served indicates the need for a generating capacity of better than 2,000,000 kw by 1960 and in excess of 3,000,000 kw by 1965. Construction budget of $33,800,000 for 1956, will include $17,400,000, for distribution lines, $9,100,000 for additional generating capacity, $5,000,000, for transmission facilities and $2,300,000, for general plant improvement.

**Milwaukee, Wis.** — The Wisconsin Electric Power Co., has announced plans for company financing of a $30,000,000 bond issue and $15,000,000 stock issue, proceeds of which will be used to repay $10,000,000 of short term bank loans and for company expansion. Company plans an expenditure of $34,000,000 in 1956 and a like amount in 1957.

# pump or packaged unit



## PHILA-FEEDER

most dependable, low-cost means of feeding water-treating chemicals.

Made by the makers of the most complete line of controlled capacity chemical pumps.

Self-contained chemical feed units comprise single or divided welded steel tanks, simplex or duplex PHILA-FEEDER pumps, gages, strainers and all necessary piping for proportioning chemicals into plant system.

# PHILADELPHIA PUMPS

PHILADELPHIA PUMP & MACHINERY CO. / 1513 Race St., Phila., Pa. / Subsidiary of American Meter Co.

For more data circle 532 on Post Card

# EQUIPMENT NEWS

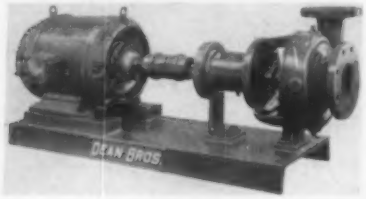
Described on these pages are new and improved products. Use Reader Service Cards on pages 123–124 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

### 1—DIFFERENTIAL REGULATOR with integral needle valve

Model H-21F Differential Pressure Regulator, incorporating a self-contained needle valve, is suggested for economical purging with air, water, or gas, in services where actual measurement of the flow is unnecessary. It can also be supplied in combination with a small flow rate indicator as a complete, compact, inexpensive purge meter package. Ranges from 0.2 to 2.0 scfh of air and 20 to 200 cc/min of water are available. Cost of the differential relay with integral needle valve is said to be about one-half the cost of many purge assemblies. Conoflow Corp.

### 2—CENTRIFUGAL PUMPS WITH standard parts for all sizes

Only three parts — impeller, casing and back head cradle — vary with the size and capacity of the GS line of seven standard centrifugal pumps for general




service and chemical service. All other parts are the same. The series comprises seven sizes ranging from 1 by 2 to 3 by 4 in. Pumping capacity extends to 600 gpm and total dynamic head to 275 ft. Pumping temperatures cover a range from −40 F to 350 F. Type GS pumps are described by the manufacturer as an inexpensive quality line of standardized pumps for a wide range of applications where conditions do not necessarily require a more costly engineered pump. Practically all of the important features of engineered process pumps are claimed to be incorporated in the GS line. Dean Brothers Pumps Inc.

### 3—COLLECTOR-DRAFT UNIT performs dual role

The Regenerative Fly Ash Collector-Induced Draft Unit combines a high efficiency fly ash collector and induced draft fan in a single easily-installed unit. Collector section removes fly ash, soot, and cinders from stack gases, and fan section provides draft for boiler operation. The collector section has been widely used for its high collection efficiency over the full load range, it is said, with a draft loss so low that it is often used in natural draft systems. The low draft loss keeps fan speed and power requirements low, it is explained, while high collection efficiency keeps stack discharge clean under all operating conditions. Units can be used for new boilers or with existing boilers requiring dust collection and increased draft to improve performance or to handle greater loads. They are available in a full range of capacities in a number of physical arrangements to fit different space requirements. Their package design makes installation simple and inexpensive, company notes, and their low power consumption keeps operating cost low. Breslove Separator Co.

### 4—HEAT RESISTANT ROPE is lightweight, resilient

Made of Fiberfrax ceramic fiber — an aluminum-silicate material that takes heat as high as 2300 F — Fiberfrax Ropes are lightweight and resilient, and offer handling and installation advantages in many high temperature applications. Thirty feet of Fiberfrax rope ½ in. in diameter weighs 1 lb, company notes, giving 50 per cent more rope length than equivalent amount of many other types. Its resiliency, a result of rope's long staple, makes it especially useful as expansion joint packing and high temperature caulking. Rope may also be used as insulator wrapping and for various high temperature gaskets and seals. Like paper, bulk and block forms of Fiberfrax fiber, rope is chemically inert and is unaffected by most furnace atmospheres, including hydrogen. Rope is made in typical three-strand form, of which 15 per cent consists of carrier-type fiber. It is supplied in coils with maximum length of 800 ft. The Carborundum Co.

### 5—STEP REGULATOR minimizes space requirements

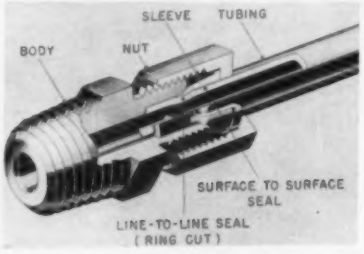
This step regulator has a new type of connection to underground conductors, eliminating top or side junction boxes by enclosing conventional bushings below the load tap changing compartment. According to manufacturer, substation appearance is enhanced by the clean, stream-lined look and installation is simplified by the large bushing compartment and by locating the bushings closer to the underground cable entrance. The modified step regulator minimizes space requirements for underground cable installations, it is noted. Allis-Chalmers Mfg. Co.

### 6—LAMP STARTER with rugged ceramic condenser

This fluorescent lamp starter has a ceramic condenser described as almost indestructible. Starters with such condensers have an extra long life, limited only by the globottle, according to manufacturer. Ceramic condensers are claimed to stand up under extreme conditions of heat, cold and humidity, and are self-healing on breakdown by high voltage surges. Tests are reported to show that ceramic starter will withstand temperatures of 300 to 500 F for extended periods. The condensers will be used initially in this company's FS-4 and FS-12 fluorescent lamp starters and in all of the 100-w lamp starters. Sylvania Electric Products Inc.

### 7—TUBE FITTING is improved self-aligning type

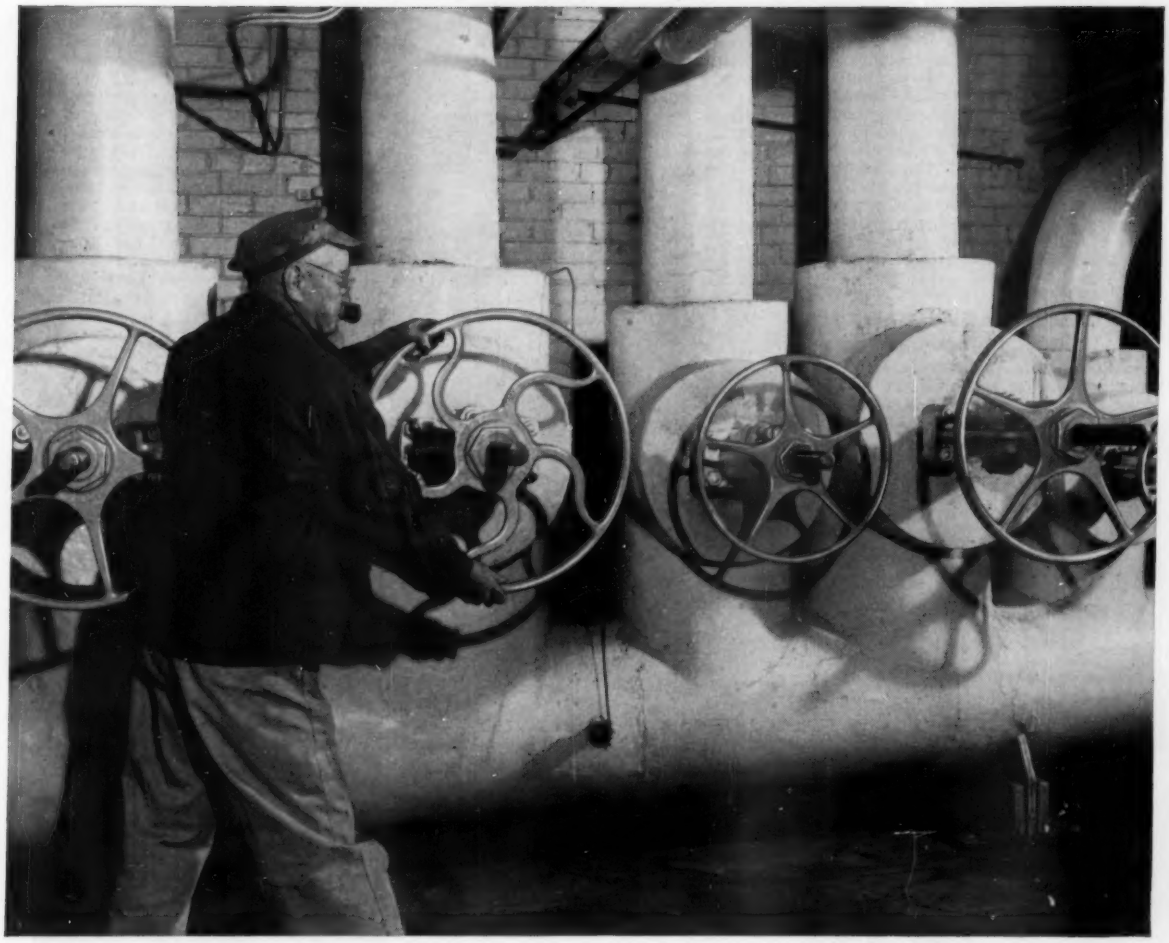
Selfalign — a self-aligning tube fitting is installed without disassembling. The tubing is simply inserted in the fitting until it bottoms and the nut is tightened. According to company, the dual sealing principle assures positive, leakproof connections. The sleeve grips the tubing over a broad area for a surface-




to-surface seal, while a thin razor edge and guiding shoulder form a line-to-line seal with the tubing as the nut is tightened. Selfalign is suited for instrumentation and all over low- and medium-pressure specifications using copper and aluminum tubing. Complete line includes union, union tee, union elbow, male and female connectors, male and female elbows, male tees for pipe on run and pipe on branch. Sizes ⅛, 3/16, ¼, 5/16, ⅜ and ½ in. in brass are available from stock; aluminum fittings may be ordered. The Weatherhead Co.

### 8—AIR CLEANER is compact packaged electronic unit

Requiring a space of only 38 in. in the direction of air flow the Precipitron Type PC is an electronic air cleaner incorporating movable washing and adhesive applications usually found only in larger units. And it is designed to af-



## 20-year veterans—all—
## with Crane "one-cost" service records

A CASE HISTORY—What better hedge could a power plant have against high maintenance costs?

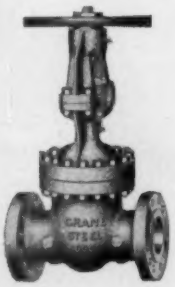
Call it foresight or sound buying practice, the Fort Bend Utilities Co., Sugar Land, Texas, knows the bigger value in quality steel valves. For 20 years now, these Crane 600-pound gates have been operating with no added cost beyond original investment, except for occasional repacking.

The valves are on a main header, with working pressure at 400 psi, 750 deg. F.

As a subsidiary of Imperial Sugar Co., the Fort Bend Utilities plant supplies steam to the neighboring Imperial Sugar refinery through the valve shown being operated. This 8-in. Crane No. 76XR steel gate has to its credit 20 years of faithful once-a-week operation with the refinery's weekend shutdowns. The other valves assure dependable steam control to units in the power plant.

Service records like this result from internal valve quality. They begin with the greater care Crane gives to design, castings, heat treating and machining.

Don't be misled by outside similarity to Crane steel valves. Get the facts from your local Crane Representative or by writing to address below.



**CRANE** VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

*Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas*

For more data circle 533 on Post Card

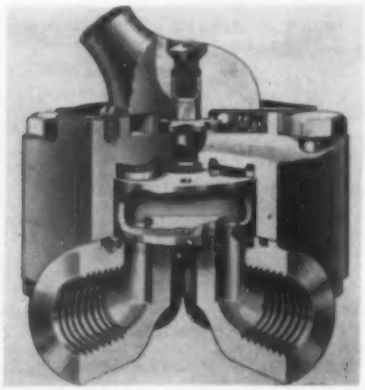
ford simplified maintenance. Both washing and adhesive application cycles are controlled and operated from outside the unit. The cleaner comes enclosed with built-in drain pan, drain connection, and duct flanges for easy installation. It has provisions for ceiling, floor or platform mounting. Designed for removing over 90 per cent of the airborne dirt, the capacities of the different models range from 2000 to 10, 640 cfm, with the length in direction of air flow 38 in. for all. Electrical input required is 115 v, single phase, 60 cycle, Sturtevant Div., Westinghouse Electric Corp.

### 9—ADHESIVE NAMEPLATE needs no drilled mounting holes

Dry-Back Nameplates of engraved Bakelite or metal feature a dry rubber-base adhesive film which permits permanent mounting without the need of drilled mounting holes. You simply reactivate the adhesive with a suitable commercial solvent, wait 5 to 10 sec, then mount with ordinary manual pressure (no clamps or vise needed) to any clean, dry surface, including one which is enameled or lacquered. No special preparation, cements, water or peeling are required. During application, nameplate may be moved about for proper alignment before applying pressure without affecting adhesion. According to manufacturer, it is not adversely affected by intermittent exposure to moisture, alcohol, alkalis, vibration, or extreme changes of temperature. It is suitable for outdoor use. Gray Pantograph Engraving Co.

### 10—SELECTOR VALVE designed for leakless service

Using the same balanced pressure principle as in their 6000 psi Lo-torq Selector Valve, this company introduces similar valves in the 0–1000 psi range, designed to give "no-leak" service in their indexed position, in most fluid services. Suggested for air, gases, hydraulic oil, non-aromatic fuel, petroleum, and water services, valve operating temperature range is −65 to 160 F. Working pressures: air and gases — 0–500 psi; liquids — 0–1000 psi. Valving disk is copper-coated steel, with stainless steel wearing surfaces. Two dynamically loaded rings of stainless, backed up by synthetic rubber O rings, are on opposite sides of disk at each port. Sealing force of these opposing rings against the faces of the valving disk is proportional to the service pressure — as pressure increases seals become tighter. Sealing rings are self-compensating for wear, company notes, and reversal of flow at any pressure, or even zero pressure, will not unseat the seals. Body material is aluminum alloy, anodized. The unit is designed for panel mounting, ¼ in. maximum thickness. Sizes range from ⅛ to 1 in., female pipe. Republic Mfg. Co.



### 11—AFTER-FILTER BAGS made of Dacron, for dust collectors

After-filter bags of Dacron cloth will now be furnished with this manufacturer's bag-equipped cyclone type dust collectors. Tests are reported to show

that the Dacron cloth is as effective as wool as a filter medium; that it will not burn when exposed to a continuous shower of sparks, will not shrink when laundered, and will not be attacked by moths or mildew. Five of company's FB (bag-equipped) models will be affected by this change, but prices will stay the same as before, it is announced. Dacron bags are also available for these models now in use. Torit Mfg. Co.

### 12—CONTROL VALVE for straight, angle installation

This two-way Flo-Control Valve, adaptable to either straight or angle installation, is used to prevent gravity circulation in a forced hot water heating system when booster pump is not in operation. Designed to reduce amount of inventory needed for this type of valve, it is available in the 1, 1¼ and 1½ in. sizes and replaces the individual straight or angle pattern valves of the same size. Valves are available in cast iron or bronze construction and in sizes from ¾ to 4 in. Bulletin HL-256 gives more details. Bell & Gossett Co.

### 13—ELECTRICAL TAPE for high voltage splicing

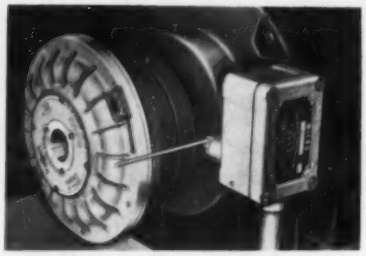
Scotch Brand No. 23 is a self bonding electrical tape for making high voltage splices. Possessing a high dielectric strength (650 v per mil), the new tape is reported to provide excellent ozone resistance and is intended for use as primary insulation on splices on insulated cables using ozone resisting compounds. After application, the tape fuses into a homogeneous mass, yielding maximum moisture resistance. Manufacturer says this tape has been applied with drops of moisture standing on it with no interference with its bonding ability. It is recommended that the ¾ in. tape be necked down to ½ in. when wrapping to provide a good moisture seal and squeeze out possible air pockets.

A 900 per cent elongation factor makes the tape's conformability excellent, even at cold temperatures, says company, and this serves to eliminate possible air voids or hot spots even at the point of overlap. Short fusing time is another advantage announced — after it has been applied for as little as 5 min. it cannot be removed without rupture. Also, No. 23 is said to have no corrosive effect on copper or silver. This tape is described workable, elastic but tough, clean to apply. Its yellow liner strips from the black tape during application. No. 23 is compatible with overwrap tapes used to provide extra physical protection to the splice. Minnesota Mining and Mfg. Co.

### 14—THERMAL CUTOUT keeps drive from overheating

Protection against overheating of Flexidyne, company's dry fluid drive, is provided by this thermal cutout. Instantaneous mechanical overload protection is inherent in the Flexidyne, it is explained: now, if an overload causes prolonged slipping and consequent heating of the Flexidyne, the thermal cutout trips the switch, cutting off the power and, if desired, giving an alarm.

The new thermal cutout is recommended especially for unattended installations. This dependable and economical device is easy to mount on the



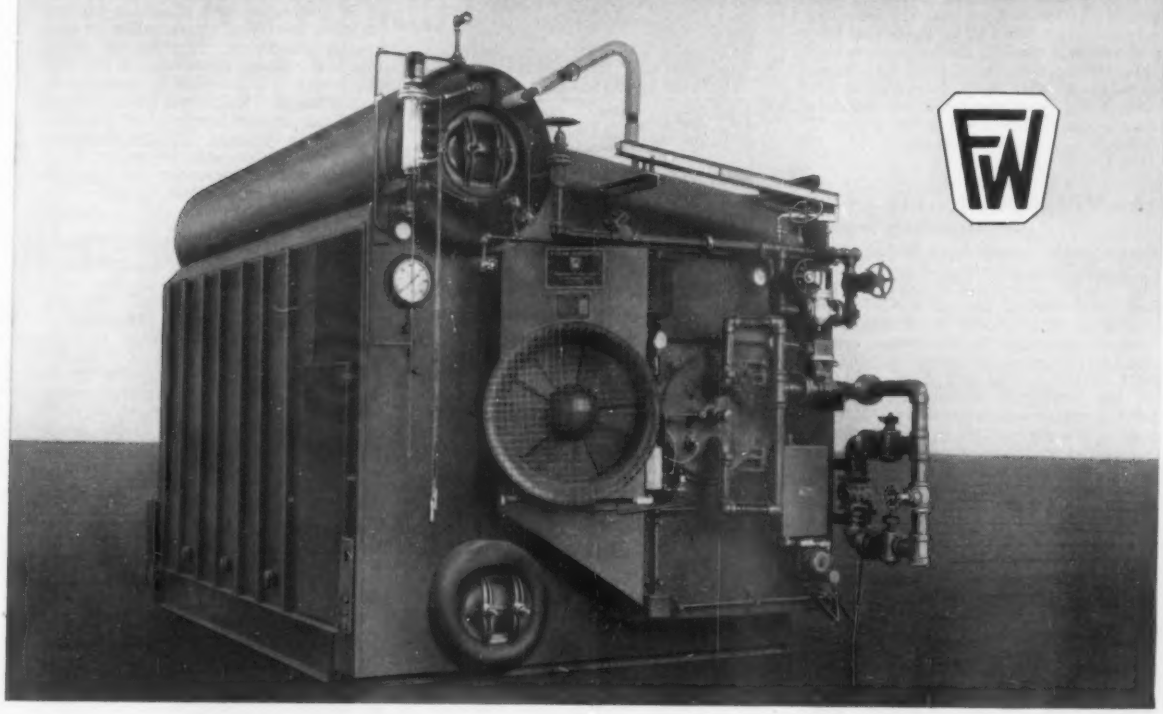
side of the Flexidyne, says manufacturer. It contains a trigger spring, held down by an alloy thermal pin. Before the Flexidyne can heat up enough to cause any damage, the thermal pin will melt, allowing the trigger to spring out so that it will push the non-sparking striker of the special switch to the "off" position. To reset the unit, you simply remove one screw, push back the trigger and insert a new thermal pin, then re-attach to the Flexidyne with the single screw. Dodge Mfg. Corp.

### 15—FIXTURE HANGER is flexible-cushioned unit

According to manufacturer, this is the industrial lighting industry's first explosion-proof and dust-tight flexible cushion fixture-hanger; it is designed to eliminate damage to fixture and stem assemblies while supporting loads to 65 lb. Action of high-strength brass bellows is aided by a stainless steel cushioning spring, to permit movement of the fixture stem as much as 15 deg from vertical in any direction. A set screw locks the threaded stem in place, and the stem assembly is designed not to turn or twist the wires or connections.

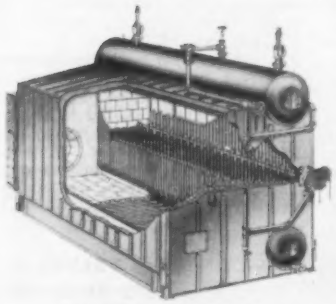
This fixture-hanger is announced as meeting NEC requirements for flexible

# REDUCE YOUR STEAM COSTS THREE WAYS



## *with the New Foster Wheeler*

# *PACKAGED STEAM GENERATOR*



**CONSTRUCTION FEATURES**

- 36" steam drum and 24" water drum
- Staggered boiler tube arrangements
- Closely spaced waterwall tubes
- Water cooled target wall
- No headers — Low circulation loss
- Light, highly efficient refractory and insulation
- Wide choice of burners and controls
- Baffled steam collector

You save on *first cost* because the FW unit is pre-engineered and shop fabricated from standard parts by the most modern, efficient and cost-saving production methods.

You cut *installation cost*, with a compact, space-saving unit that's shipped completely assembled — all ready to set on a simple foundation — all ready for your fuel, steam and electric connections.

You save *operating cost* all year 'round, because FW Packaged Steam Generators are designed for high sustained efficiency and exceptional ease of inspection and maintenance.

The NEW Foster Wheeler Packaged Steam Generators, in capacities from 10,000 to 46,000 lb/hr, represent the last word in modern steam plant design, reflecting more than 50 years of service to the power generation industry.

***For complete details, send for Bulletin No. PG-55-3.***
***Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.***

## FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

**For more data circle 534 on Post Card**

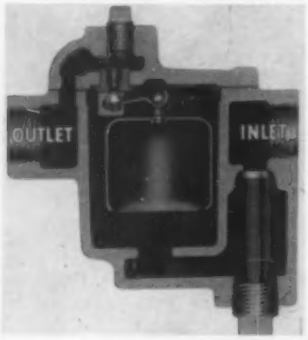
support of pendant fixtures on rigid conduit stems longer than 12 in. One complete assembly of Condulet and cushion fixture-hanger does the job, says company; no bracing or separate flexible device is needed. Factory-assembled fixture-hangers with junction Condulets come in ½- and ¾-in. hub and fixture stem sizes. Also available are separate fixture-hangers for CPS Series Form 20 Condulets. Crouse-Hinds Co.

### 16—DEAERATOR for use where headroom is limited

Particularly applicable in boiler rooms of single story plants and other buildings where head room is normally limited, this line of deaerators comprises four sizes up to 80,000 lb/hr capacities. Larger capacities in the same design can be fabricated. Elevated installation isn't required. The new design consists of the standard steam-jet deaerator with a pump mounted below, forming part of the entire unit. Pump suction is connected to a large down comer which is equipped with an anti-vortex baffle and strainer. The high suction characteristics provided by this arrangement increase the pressure of water leaving the deaerator to the pressure required at suction of the boiler feed pump. This design eliminates the necessity of elevating the deaerator above the boiler feed pump, it is explained, and thereby reduces supporting structures and piping arrangements. Use of company's deaerator recirculation design prevents the pump from becoming vapor bound and provides maximum deaeration under abnormal operation. The new design permits recirculation of stored water through the deaerator; to heat the water and remove oxygen before water is fed to boiler. Worthington Corp.

### 17—STRAINER TRAPS are economical, efficient

Newest of company's Thriftrap line, these strainer traps are said to offer fast removal of all condensate plus a built-in strainer for the protection of equipment. The combination strainer




traps are reported to cost less to buy and install, less to maintain, than many standard traps plus strainer. Traps are of cast semi-steel construction with either standard or Duo-step leverage. Seats and discs are of stainless steel, resistant to corrosion, wire drawing or cutting. The traps are designed for pressures up to 250 psi, and temperatures up to 450 F, and are equipped with horizontal inlet and outlet connections. The Clark Mfg. Co.

### 18—ELECTRONIC INSTRUMENT aids in noise control

Described as the first instrument to combine in a single, portable unit four functions necessary to measure and analyze noise accurately, the 20-lb Soundscope serves as a meter to measure overall sound levels. It is also an analyzer. Electrical and acoustical calibrators are built in.

Key to the industrial noise problem is the human factor, it is pointed out. While noise intensity and frequency can be measured, the effect on human hearing is governed by variables of age, physical condition, duration of exposure and other elements. With the Soundscope it is possible to make noise contour maps of industrial areas. Round level readings and analyses of frequencies and intensities at different distances from noise sources can be made. With this information measures can then be taken to eliminate noise at the source or to isolate the noise, and to protect individuals exposed.

When used as a sound level meter, the Soundscope picks up noise through its microphone which acts to transform sound into electrical energy. The reading appears on the meter calibrated in decibels. Measurement range is from 24 dec (about that of a quiet home) to 150 dec (worse than an air-raid siren). In the analyzer section of the instrument, noise is filtered into any of eight principal octave bands — noise peaks in each of these can be then measured. Mine Safety Applicances Co.

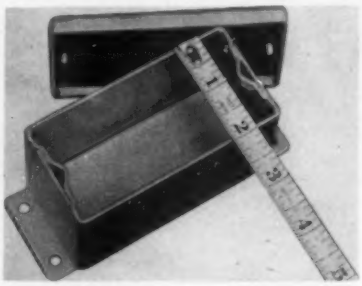
### 19—TIME SWITCH features reliability at lower cost

The TSA-40 General-Purpose Time Switch is suitable for indoor and outdoor use, and designed to turn electric circuits on or off at any time of day. It can be used to control all types of lighting, capacitor switches, heating, air-conditioning and refrigeration equipment, pump devices, and other apparatus where precise time control is essential. An outstanding feature announced is the shearing action of contacts which are forced to slide against each other as they open and close, preventing welding and keeping contacts clean under heavy overload conditions.

Unit construction of terminal block and contacts eliminates internal wiring which helps prevent hot spots and burnouts, company points out. Operator safety is increased by dead-front construction which allows adjustments to be made with terminal shield in place, without possibility of accidental contact with terminals. Unit has a 4-w Telechron motor, designed for positive operation from −50 to 150 F and having permanent silicone-grease lubricant sealed in. Switch is furnished with either a plain dial for fixed time setting or an astronomic dial for dusk and dawn schedules. One or more may be skipped during week's operationg with omitting device. The windowless zinc-coated steel case has a pressure-action latch with a Neoprene gasket. Operating voltage of the TSA-40 is 120, 240, 480 v-a-c. Frequency is 60, 50, and 25 cycles. It weighs 4¾ lb. net. General Electric Co.

### 20—ARMORED CABLE with thermoplastic insulation

Thermoplastic insulation employed on the individual conductors of this BX armored cable eliminates need for braid on the singles, it is announced, provides color-coding that goes all the way through, and makes stripping quicker and easier with no time wasted in trimming braid. The new armored cable is available in two, three, and four conductors in all standard sizes. It is listed by Underwriters' Laboratories; rated 600-v. General Electric Co.



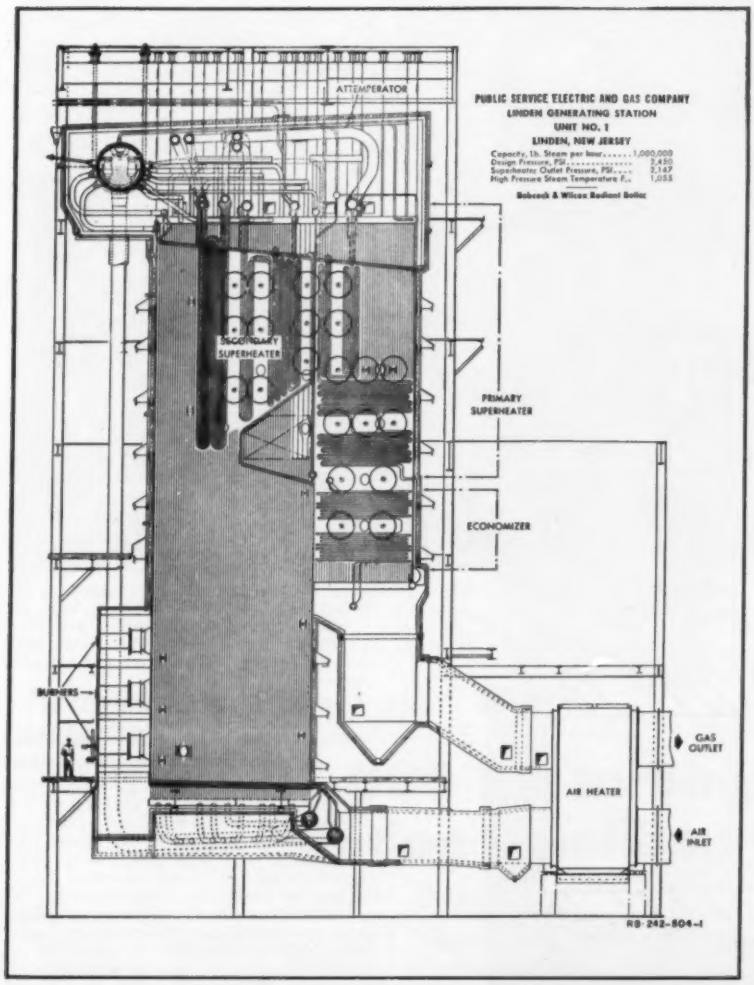
### 21—WIRING BOX, oil tight, of fabricated steel

Model 402 is announced as a small oil tight sheet metal wiring box particularly suitable for use with flexible, liquid tight electrical wiring conduit. The size is 4 in. long by 2 in. wide by 2 in. deep. Cover has a Neoprene gasket. The captivated cover screws thread into blind holes in the box. Two mounting feet are spot welded to the box. All seams are welded; the material is 14-gage steel, and the box is finished with baked enamel grey hammertone over a phosphatized surface. Hoffman Engineering Corp.

### 22—CONTROL VALVES in two simply-designed types

Designed to handle all fluids at unlimited pressures, are two new control valves — the diaphragm-actuated Type CV-D and the piston-actuated Type CV-P. The CV-D Valve has a wider range of application than company's older-style diaphragm-actuated valves, and may be direct or reverse in action. Simple in design and easy to maintain, the CV-P Valve also has extreme rangeability, says manufacturer; this valve has desirable operating characteristics and its piston actuation develops high force to deal with static and dynamic unbalances and with stuffing box friction. Valves are designed for water, steam, air, gas, oil or other similar fluids at unlimited pressures. Each valve opening is designed to provide correct flow at all times. Valve bodies are made

# It's Vulcan Automatic-Sequential at Linden Generating Station



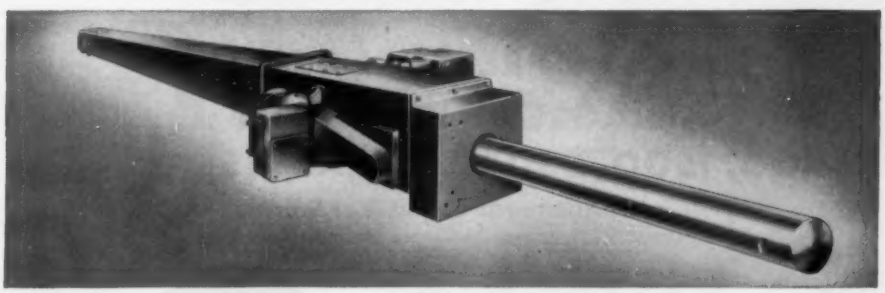

Two of the retractable soot blowers at Sewaren Generating Station are Vulcan T-30 Long Retractables with 33 feet 2½ inches travel, the longest soot blowers built at the time they were installed. Their performance opened the door for a single installation on the new and larger twin-furnace boilers, with substantial overall savings to the user. It was a prime factor in the selection of Vulcan Automatic-Sequential Soot Blowing for the new Linden Generating Station of Public Service Electric and Gas Company.

This semi-outdoor station will have four Babcock & Wilcox radiant boilers with pressurized furnaces. Three of them—each with capacity of 1,000,000 pph at 2147 psig and 1055 F—make up Unit 1. Unit 2, a twin-furnace boiler with reheat, is rated at 1,900,000 pph at 2373 psig and 1100/1050 F.

The Vulcan T-30 Long Retractables to be installed on these units will have travels up to 33 feet. The T-30 Half-'Tracts will travel up to 16½ feet. Blowing medium: air. Drive: electric.

Effective, economical boiler cleaning is assured with the Vulcan Automatic-Sequential System. Any blower can be cut in or out of the automatic sequence—or blown individually from the panel. Control is at the operator's finger tips. And each blower reports its operation back to the central panel.

No matter what size your boilers —whether power or process—depend on Vulcan for optimum cleaning results.



Vulcan T-30 Long Retractable Soot Blowers have been built for travels in excess of 35 feet to reach the most remote passes of steam generators. They are designed and built for long service life under the most rugged operating conditions.

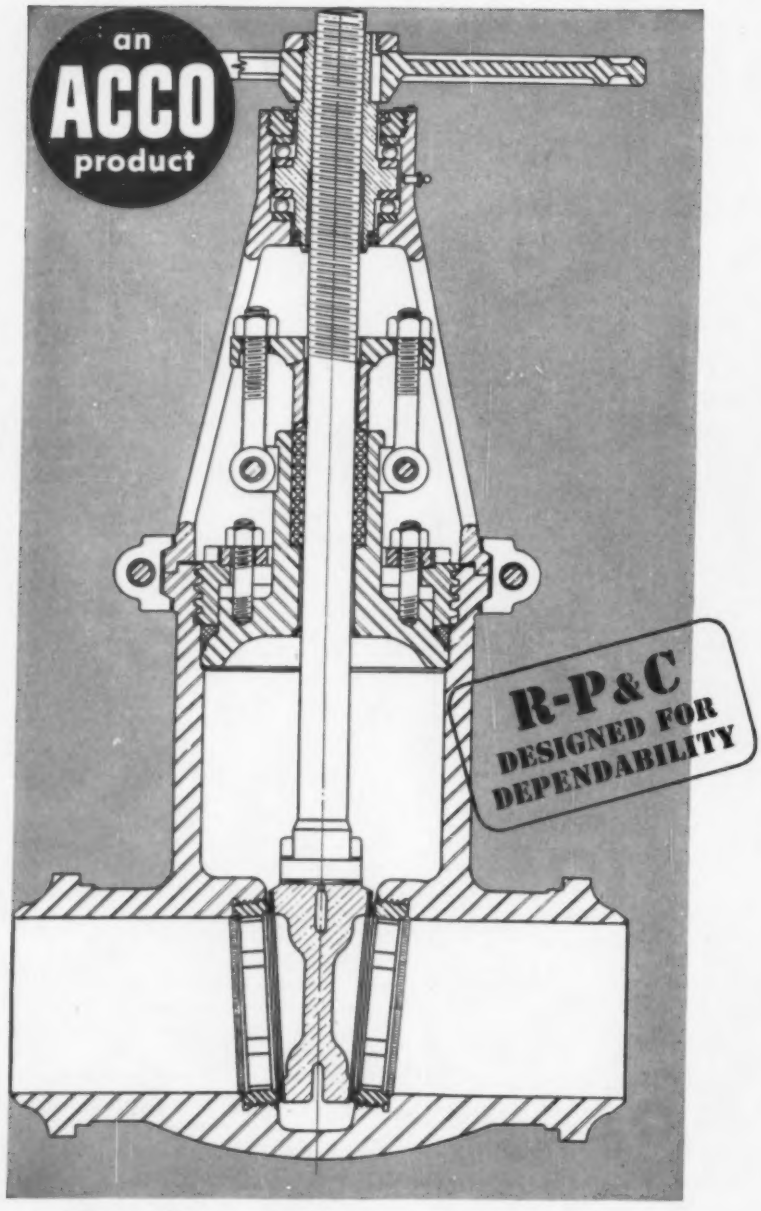
COPES-VULCAN DIVISION

**BLAW-KNOX COMPANY**

ERIE 4, PENNSYLVANIA

50th Anniversary BLAW-KNOX 1906-1956

For more data circle 535 on Post Card




**R-P&C PRESSURE SEALED**
**GATE AND GLOBE VALVES IN 900, 1500, 2500 LB. CLASSES**

*For complete information write our office at Reading, Pa.*

ACCO

**R-P&C Valve Division**
**AMERICAN CHAIN & CABLE**

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

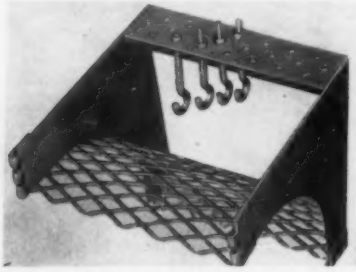
**Better Values**

For more data circle 536 on Post Card


of cast iron or cast steel in straightway or angle style. Designed for individual installations, the fittings are stainless steel, single or double seat, with hard-facing when required. Copes-Vulcan Div., Blaw-Knox Co.

### 23—RISER ELBOW for supporting cable runs

This cable supporting riser elbow has been added to other standard fittings in company's expanded metal cable trough system. The riser elbow is designed to provide for "J" hooks from



which cable grips can be hung to support long, vertical cable runs. The elbows are available in widths of 6, 9, 12, 18 and 24 in., the widths of the cable trough. Corresponding maximum numbers of "J" hooks for each width are 10, 16, 22, 34, and 46. The expanded metal cable trough is widely used as a support for power and control cables. It is described as the lowest cost type of support for flexible cable because of savings afforded in labor and materials. Electrical properties of the trough are said to permit higher cable current air ratings. T. J. Cope, Inc.

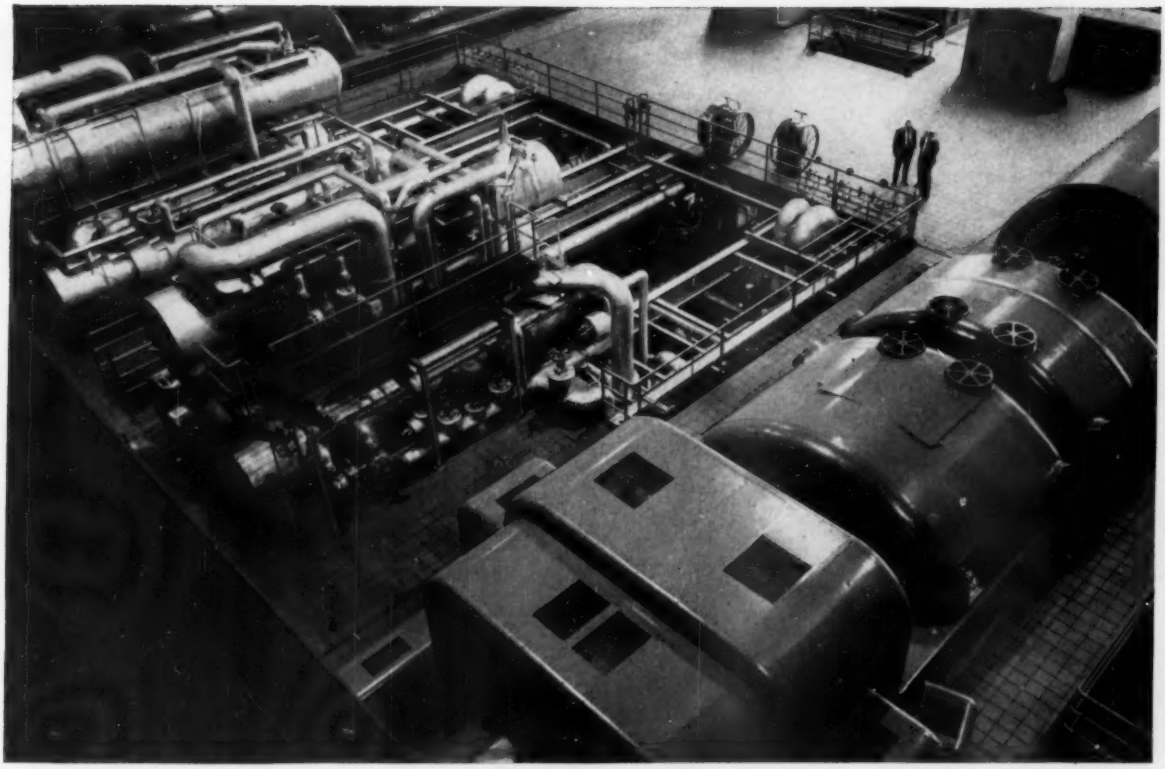
### 24—CENTRIFUGAL PUMP handles fluctuating volume, head

Offered to meet the need for a centrifugal pump with specific characteristics for handling a given head and volume of water at peak efficiency, the Model BL Centrifugal Pump is designed to provide high efficiency over a broader range of service conditions. Each size handles a wider-than usual range of pressures and capacities, says manufacturer, and each will accommodate fluctuations in either pressure or capacity without serious loss of efficiency. Model BL is available in five sizes of 2, 3, 4, 5, and 6 in. Each size is designed with factory lubricated, heavy-duty ball bearings, and has an extra large shaft to maintain alignment, and a strong supporting frame. A mechanical seal is incorporated. Gardner-Denver Co.

### 25—PIPE TOOL repairs leaks quickly, economically

Described as simplicity itself, this tool consists of pipe clamp and patches shaped to fit specific pipe sizes and provide a skin-tight fit when gasket is compressed. The pipe tool is made in a saddle type in four sizes for use on pipe 6-in. diam. and less; and a chain type in all sizes from 6 in. up to any size. Patches are steel with Neoprene or asbestos gaskets. Patch of other materials can be ordered.

Because of its light weight one man can handle this tool. The clamp is



***Operate at high temperatures.*** Final stage boiler feedwater heaters at Philadelphia Electric Company's Delaware Station are tubed with ¾" O.D. 17-gauge Monel tubes. Designed and built by The Lummus Company, the heaters use 820°F. steam in the fifth stage, 623° and 745° steam in the sixth and seventh stages, respectively.

## *Heaters have* Monel *alloy tubes*

# Two 125,000 kw turbine-generators put station in million-plus class

***A seven-stage feedwater heating system*** serves each of two 125,000 kw turbine-generators at the Delaware Station of the Philadelphia Electric Company.

The last three of the stages are high pressure. They operate at 2,000 psi on the tube side, and use steam up to 820°F to raise the water temperature to a final 500° to the economiser.

Twenty-seven miles of "U" tubes were used in the three final stages of feedwater heating. The engineering department of the Philadelphia Electric Company selected Monel* nickel-copper alloy for them.

***A wise choice!*** It has high strength at the temperatures and pressures involved. Wall thickness can be held to a minimum. And this, of course, means good heat transfer. Monel alloy — like all Inco Nickel Alloys — is corrosion-resisting, long-lasting.

Monel alloy has other important properties, too. Its coefficient of expansion, for example — so close to steel's that rolled tube ends don't tend to shrink away from the tube-sheet during cooling in shutdown periods. Yet ductile for rolling.

***Consider Monel nickel-copper alloy*** the next time you design, install or re-tube a high-pressure heater. And to make sure you have full information on hand when you need it, write us *now* for a copy of Technical Bulletin T-9, *Engineering Properties of Monel.* It's yours for the asking.

*Registered Trademark

**The International Nickel Company, Inc.**
67 Wall Street New York 5, N. Y.

**More POWER for you... with MONEL** — **INCO NICKEL ALLOYS** (TRADE MARK)

**For more data circle 537 on Post Card**

KIRK & BLUM

SHEET and PLATE FABRICATION for POWER PLANTS

Whatever your requirements in sheet and plate fabrication . . . such as the mammoth breeching section shown here . . . call on KIRK & BLUM.

During the past 50 years, Kirk & Blum has acquired exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

Send prints for prompt quotations on your requirements, or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

• BREECHINGS • STACKS • AIR and GAS DUCTS
• CASINGS • LOUVERS • BINS and HOPPERS
• INSULATION JACKETING
• ALUMINUM and ALLOY FABRICATION
• CONTROL PANELS and DESKS

THE KIRK & BLUM MFG. CO.

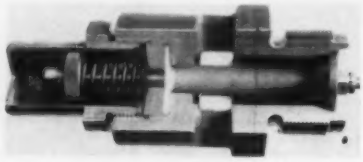
3230 Forrer Street • Cincinnati 9, Ohio

For more data circle 538 on Post Card

placed around the leaking pipe — without shutting off line, reducing pressure or causing any loss of time or flow. Patch is applied directly over leak and sufficient pressure applied by the clamp to stop leak. The patch can then be welded to pipe, or clamp can be left on until it is convenient to weld the patch. The permanent patch seals the leak — and is as strong as the pipe itself, says company. These tools have been tested under pressures to 6000 psi. For areas where welding is hazardous or prohibitive, manufacturer has developed a cold-weld process for welding patch to pipe. Atlas Industries, Inc.

### 26—SPRAY VALVE eliminates sticking, is non-scaling

Designed for applications such as feedwater heaters, deaerators, hot process water softeners, cooling towers, aerators, degasifiers and spray ponds, the D-J Spray Valve is so constructed that the valve stem, stem guide, and valve spring



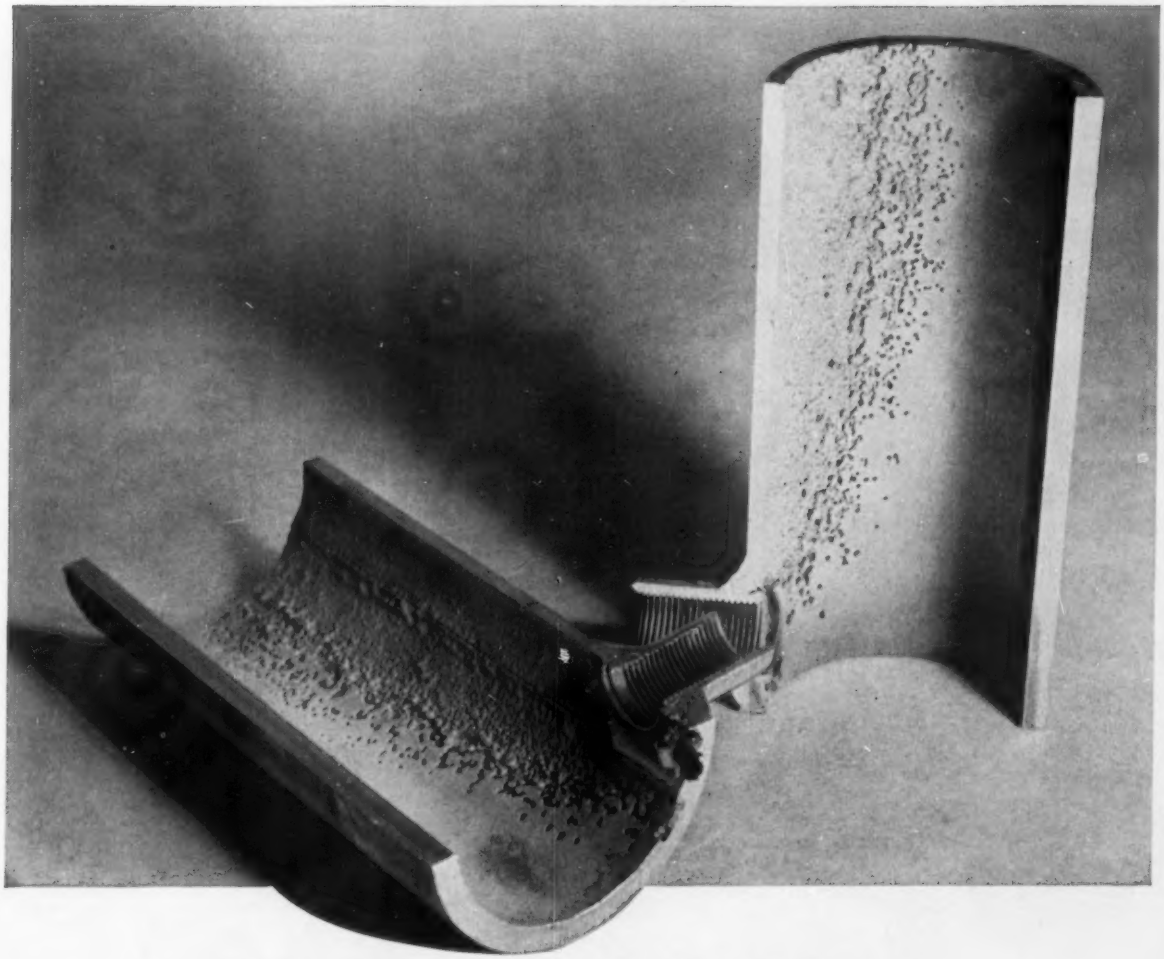
are enclosed in a liquid-tight chamber to prevent scaling. A special elastic sleeve permits free action of the valve and seals all moving parts from contact with the sprayed liquid. According to manufacturer, the new design eliminates the formation of scale deposits on the valve stem. Introduced in 1- and 1½-in. sizes, the valve construction is of bronze or stainless with approximate pressure drops from 4 to 5 psig at maximum flow. The elastic seal is designed to withstand temperatures to 450 F. Griggs Machine Co., Inc.

### 27—MACHINE for stringing power line conductors

Model 6000-WS, for stringing overhead power line conductors under controlled tension, takes conductor sizes up through 1¾-in. diam and any size and type of reel on which these conductors are currently provided from the wire mills. The braking takes place over the double bull wheels made of cast aluminum alloy and Neoprene lined to prevent damage to conductors and slippage. One reel can control the brakes on one of these units holding two wheels, it is noted, or with two units placed close together, stringing up to four conductors simultaneously. Operation of the machine is declared extremely smooth. Petersen Engineering Co.

### 28—CHEMICAL COMPOUND to prevent, remove scale

Ke-Tone is announced for the prevention or removal of hard water scale building up on or in valves, pipes, tanks, cooling towers, evaporators, boilers, heat exchangers. The method is described as effective and economical. Ke-Tone is added to water at the rate of 1 lb to 200,000 grains of contained water hardness, or from 3 to 5 ppm — which gives the highest concentration of treating agent. A daily check on the



# PIT-POCKED PICKPOCKET

In power-demanding industries, pitted pipe means out-of-pocket expense. The annual losses in labor and materials to replace equipment damaged by cavitation and corrosion reach staggering proportions.

The corrosive attack against this pipe was accelerated by mechanical action. Cold water injected into a high-pressure condensate return line caused steam collapse, resulting in violent hammering and cavitation-erosion damage. Because shock forces disrupted protective films on the interior surface of the pipe, failure occurred rapidly in this short section.

Dearborn Engineers spotted the cavitation problem, and recommended design changes which eliminated the trouble. Thereafter the entire return line system was fully protected by Filmeen.*

Dearborn Filmeen, a concentrated amine treatment, forms a continuous corrosion-inhibiting barrier between condensate and metal. This non-wettable film protects against both carbonic acid and oxygen corrosion. Filmeen readily disperses in hot condensate, permitting continuous feed direct to boiler or steam system.

Take advantage of Dearborn's Water Treatment and Engineering "know-how." Your Dearborn Representative will demonstrate Filmeen's efficiency in combatting destructive corrosion. He will survey your system and recommend control measures and feeding arrangements best suited to your plant requirements. The coupon will bring full details.

**FILMEEN—U.S. Pat. No. RE-23614 reserves to Dearborn Chemical Company and its licensees exclusive right to the use of octadecylamine for water treatment.*

Dearborn®

**combatting corrosion wherever it occurs**

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PG
Chicago 54, Ill.

☐ Have a representative call.

☐ Send me more information on Dearborn Filmeen Water Treatment Service.

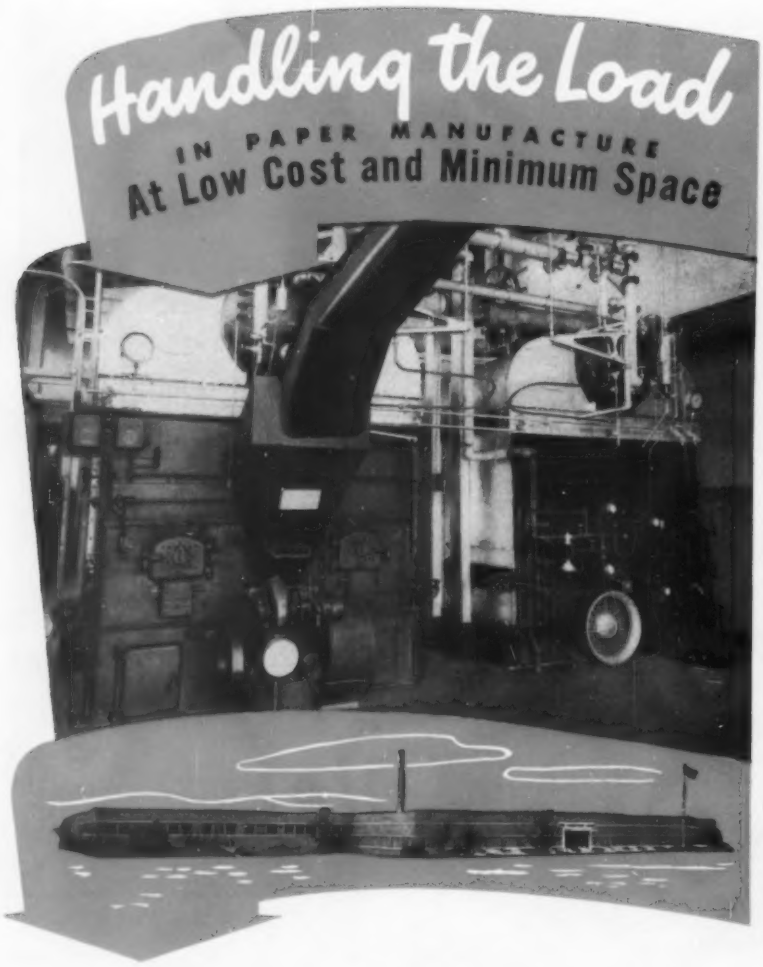
*Name*.....*Title*.....

*Company*.....

*Address*.....

*City*.....*Zone*.....*State*.....

**For more data circle 539 on Post Card**




# TITUSVILLE TICOTHERM

## STEAM GENERATORS

For Paper Manufacturers Company, at their Bustleton, Pa. plant, two main types of firing are handled efficiently by these Titusville TICOTHERM Steam Generators. No. 1 boiler has a ram-type underfeed stoker, No. 2 is equipped with oil burner for standby, providing flexibility for all processing and heating needs of the large plant pictured.

*Write* for your copy of informative Ticotherm Bulletin B-3250A —sent promptly on request.

THE TITUSVILLE IRON WORKS COMPANY
TITUSVILLE, PA.

A division of Struthers Wells

*Manufacturers of* A Complete Line of Boilers for Every Heating and Power Requirement

For more data circle 540 on Post Card


water in the system shows a gradual but continuous rise in its hardness, company explains, and this is due to the fact that scale already deposited is disintegrating or going back into solution. Continuous or frequent blowdowns keep hardness at reasonable levels, it is noted, and when the system is free of scale the hardness will return to its initial level.

According to company, Ke-Tone, by a degradation process, acts to suspend scale particles in areas which favor precipitation, and lets the scale dissolve in other parts of the system where solubility product relationships favor solution of the scale. Use of Ke-Tone is claimed not to change equilibrium to favor precipitation of calcium or magnesium from the water. The compound is also said to reduce or eliminate algae growth. The United Chemical Corp. of New Mexico.

### 29—DRIVE SYSTEM for synchronized speed changes

The Varidyne is a system of synchronized variable speed, multiple drives. Heart of the system is a power unit which interlocks Varidyne motors by electrical impulses, it is explained; turning the control dial on this power unit varies the speed of every motor in the system equally and simultaneously. Varidyne motors are of the a-c squirrel-cage induction type, connected to the power unit by standard three-phase circuitry.

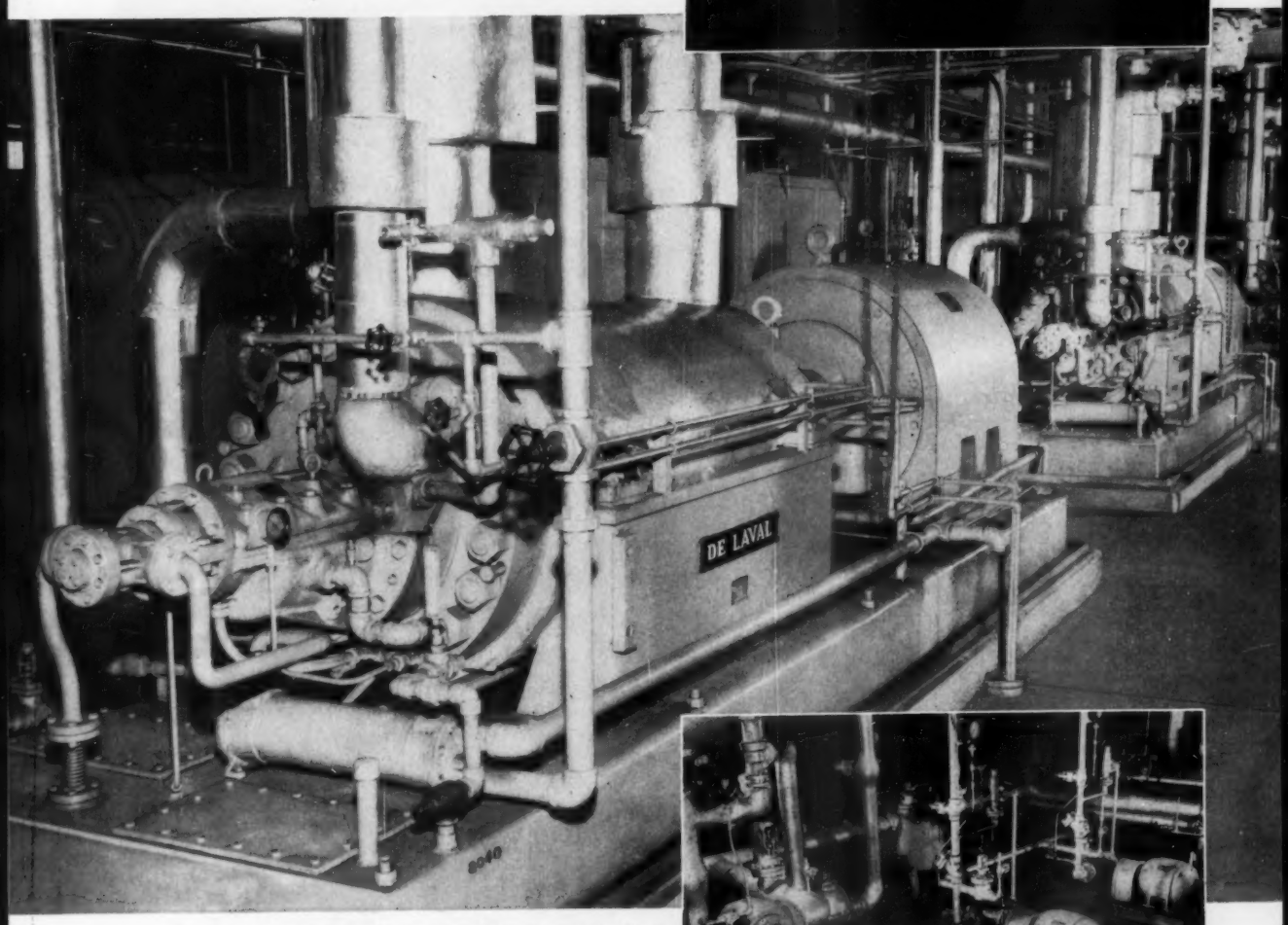
According to manufacturer, this system is easy to install and affords a practically unlimited selection of motor types. Enclosures available include drip-proof, totally-enclosed and explosion-proof designs. Speeds from 1 to 10,000 rpm are available in ratios of up to 5:1, higher speed ratios can be supplied. Motors can be furnished from ½ to 25 hp at maximum rpm, and power units are available to carry from 1 to 50 hp connected load. A characteristic attributed to the Varidyne system is that when the motors are operating in tandem, they will equally share the load, eliminating damage from overloads at any one point in the system. U. S. Electrical Motors Inc.

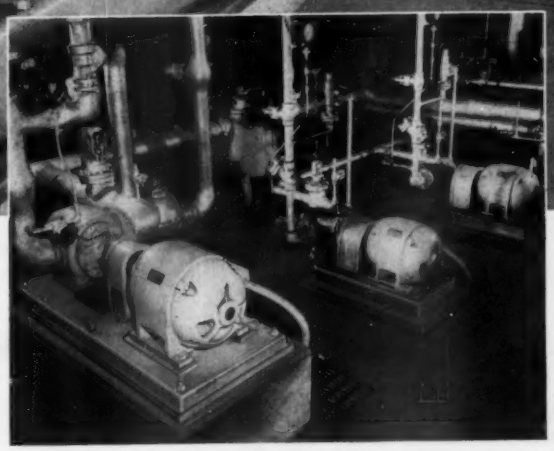
### 30—SLIDE VALVE sectionalizes hydraulic piping system

Designed especially for use in pipelines transporting solid materials in liquids, the A-S-H Slide Valve is employed to sectionalize branches of the piping system to direct the flow through a desired course. Available in 6-, 8-, and 10-in. sizes for a maximum pressure of 125 psi, valve provides straight through flow in the open position with full pipe diameter. The slide gate extends through stuffing box in both ends of valve body to avoid possibility of solids lodging around slide gate and interfering with full opening and closing. Valve is assembled in a frame consisting of four steel angles. Valve body is a one-piece iron casting attached to angle frame; outer ends are plain for connection to plain-end pipe by a sleeve coupling. The ¼-in. thick plate slide gate can be removed at either end of valve. The slide valve will be available for either manual or power operation. For the latter, the valve is equipped with operating cylinder using compressed air, water or oil. The Allen-Sherman-Hoff Company.

# *Atlantic City Electric ... another utility using*

# DE LAVAL
## BARREL TYPE BOILER FEED PUMPS



De Laval IMO rotary positive displacement pumps handle heavy fuel oil. They are used for standby operation.

Atlantic City Electric Company knows it can count on De Laval reliability. Three De Laval high pressure, barrel type boiler feed pumps are on the line at their Deepwater Station in Penns Grove, New Jersey. These 10-stage units deliver 675 gpm, operating at 1762 psi with temperature at 287 F. The pumps are driven by 900 hp motors.

De Laval barrel type boiler feed pumps operate at pressures up to 5500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, only one inner high-pressure joint, and bare shaft construction. Their dependability is proven by year in, year out service in public utilities and industrial plants.

*Send for De Laval Bulletin 1506, which contains helpful data.*

**DE LAVAL** *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
*816 Nottingham Way, Trenton 2, New Jersey*

GL-343

# You don't pay for sludge like this when you buy Morton Purex Salt

When you buy Morton Purex Salt, you get high purity evaporated salt that is made in a controlled-particle size to prevent packing and channeling. None of your freight bill or purchase price goes toward paying for shale and sulphates . . . insolubles like those shown on the filter pad above. (And the cost can be considerable. In every 100 lbs. of any type of rock salt, you are paying for up to 5 lbs. of insolubles.)

With Purex, no time or labor is spent in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex will leave no accumulation of material in either brine or water softener tanks. It can be used in bulk wet-storage systems, and in the Morton Model-E Brinemaker.

For more information about Morton Purex Salt, or for free, expert help on any water-softening or brine-making problem, write or wire:

**MORTON SALT COMPANY**
INDUSTRIAL DIVISION
Dept. PoE-6, 120 So. La Salle Street, Chicago 3, Illinois

For more data circle 542 on Post Card

# Guaranteed TO SHUT TIGHT*

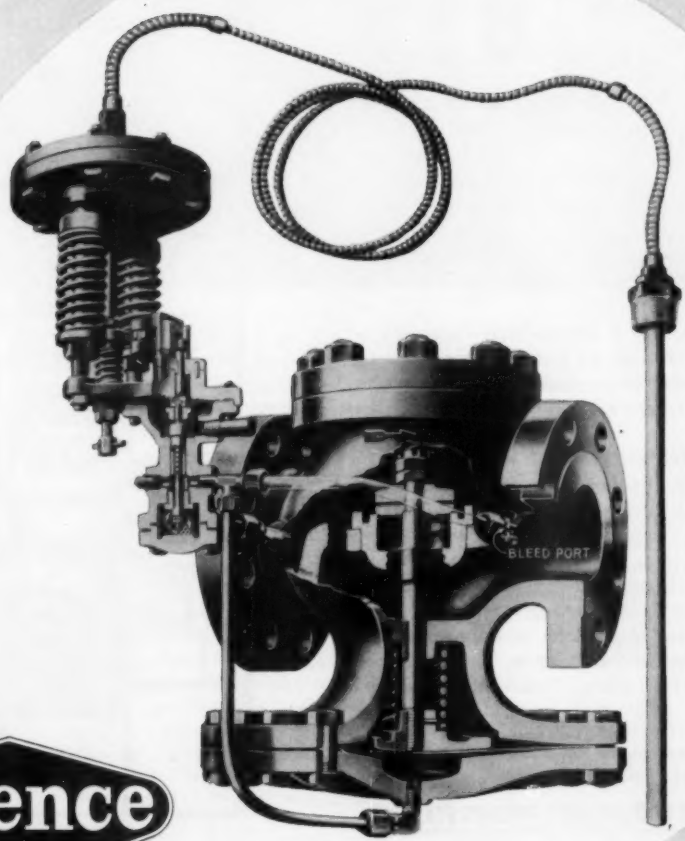
* When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.




SPENCE
TYPE ET150
Temperature
Regulator

Spence

**SPENCE ENGINEERING COMPANY, INC.**
**WALDEN, NEW YORK**

SE 189

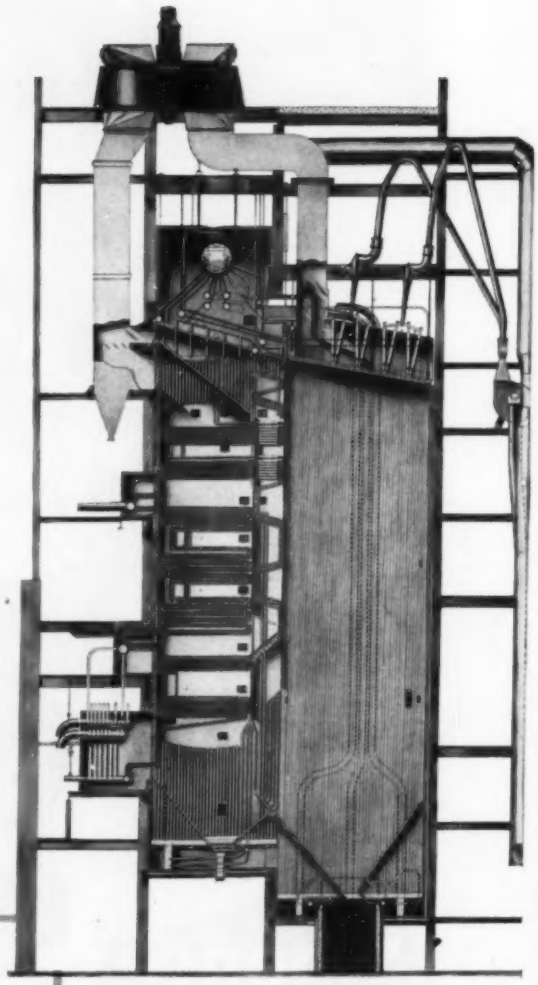
For more data circle 543 on Post Card

Now on the Line at Duquesne Light

# 1,060,000 lb/hr

## Reheat Steam Generator by FW

***Sixth Foster Wheeler Steam Generator at Phillips Station marks latest expansion of Duquesne system ... an expansion that will soon include atomic power at Shippingport, where FW Steam Generators will also serve***



The capacity of the Phillips Station of Duquesne Light Company was increased by 156,200 kw when Unit No. 4 went on the line in January 1956. This, the largest and most efficient unit in the Duquesne system, is served by the 1,060,000 lb/hr Foster Wheeler reheat-type steam generator shown at the right.

The addition of Unit No. 4 brings total capability of Phillips Station to 382,000 kw. *All four* of these units are powered by Foster Wheeler steam generators — a tribute to customer satisfaction that dates back to the first installation in 1942.

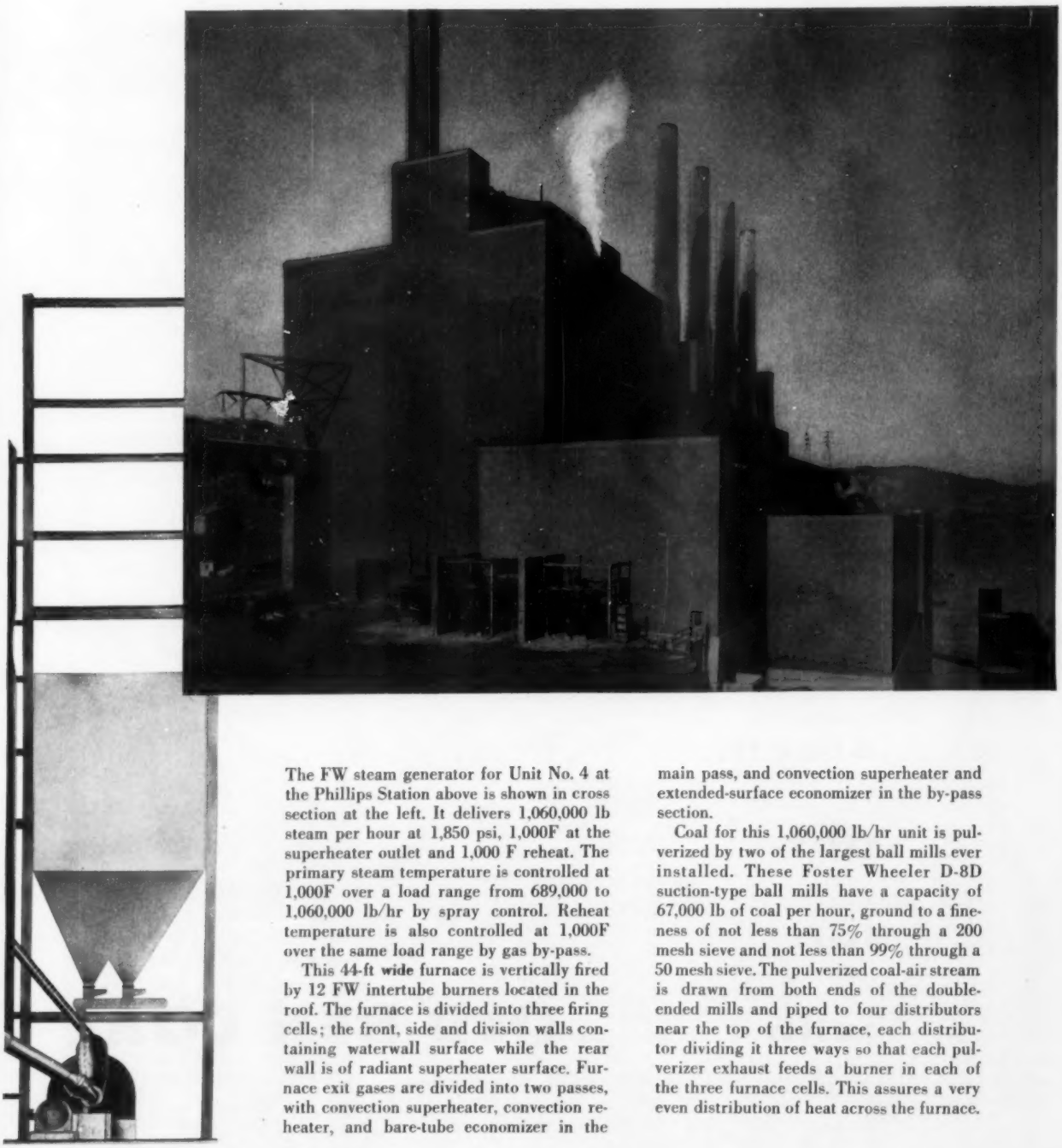
In the nation's first full scale atomic power plant, now under construction at Shippingport, Pa. and scheduled for completion in 1957, two Foster Wheeler steam generators (heat exchangers) will be used to convert heat from the nuclear reactor to 600 psi steam.

Whatever your Power Plant requirements — from coal or oil firing to nuclear energy — heat engineering by Foster Wheeler means efficient and dependable steam generation at low overall cost. For further information, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

**FW STEAM GENERATORS AT DUQUESNE'S PHILLIPS STATION**

**1942 — TWO twin-furnace units, 500,000 lb/hr, 900 psi, 900F**
**1949 — ONE twin-furnace unit, 700,000 lb/hr, 900 psi, 900F**
**1950 — TWO twin-furnace units, 700,000 lb/hr 900 psi, 900F**
**1956 — ONE divided-furnace, reheat unit, 1,060,000 lb/hr, 1850 psi, 1000/1000F**

# Company's Phillips Station:



The FW steam generator for Unit No. 4 at the Phillips Station above is shown in cross section at the left. It delivers 1,060,000 lb steam per hour at 1,850 psi, 1,000F at the superheater outlet and 1,000 F reheat. The primary steam temperature is controlled at 1,000F over a load range from 689,000 to 1,060,000 lb/hr by spray control. Reheat temperature is also controlled at 1,000F over the same load range by gas by-pass.

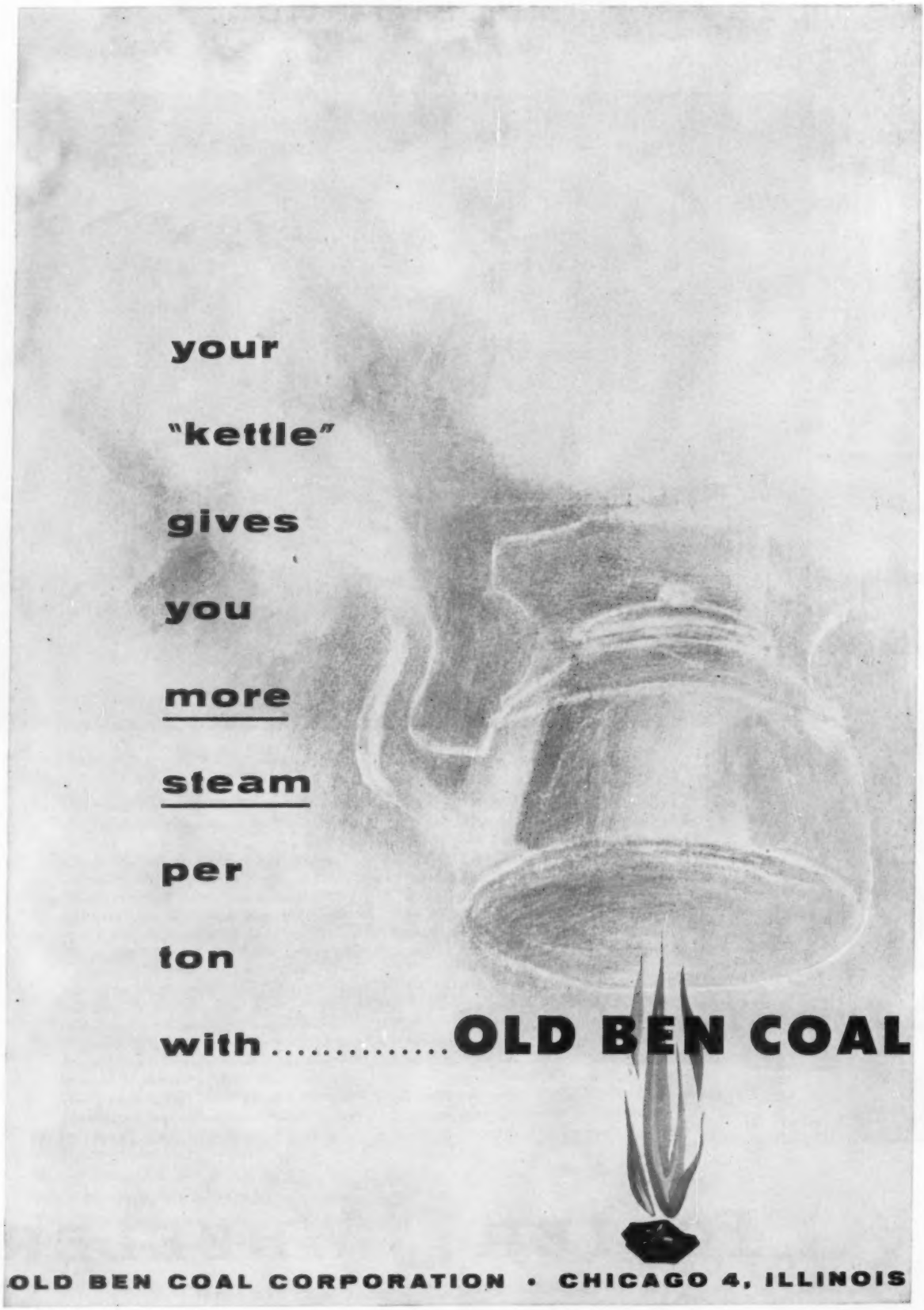
This 44-ft wide furnace is vertically fired by 12 FW intertube burners located in the roof. The furnace is divided into three firing cells; the front, side and division walls containing waterwall surface while the rear wall is of radiant superheater surface. Furnace exit gases are divided into two passes, with convection superheater, convection reheater, and bare-tube economizer in the main pass, and convection superheater and extended-surface economizer in the by-pass section.

Coal for this 1,060,000 lb/hr unit is pulverized by two of the largest ball mills ever installed. These Foster Wheeler D-8D suction-type ball mills have a capacity of 67,000 lb of coal per hour, ground to a fineness of not less than 75% through a 200 mesh sieve and not less than 99% through a 50 mesh sieve. The pulverized coal-air stream is drawn from both ends of the double-ended mills and piped to four distributors near the top of the furnace, each distributor dividing it three ways so that each pulverizer exhaust feeds a burner in each of the three furnace cells. This assures a very even distribution of heat across the furnace.

**FOSTER WHEELER**

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

**For more data circle 544 on Post Card**

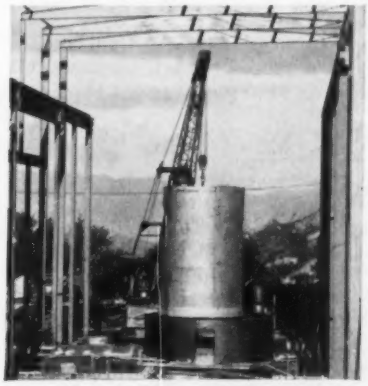



For more data circle 545 on Post Card

# NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

## Principal Technical Details of the Sodium Reactor Experiment in California

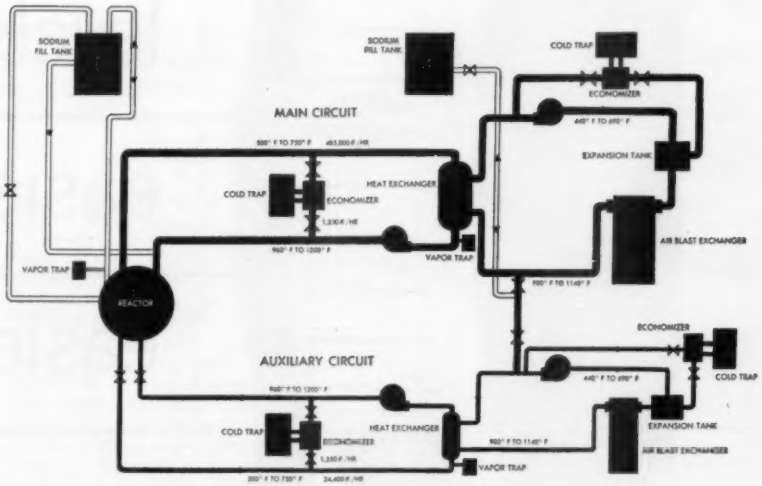
The Sodium Reactor Experiment is an important contribution to the Atomic Energy Commission's program to develop economical power from nuclear energy. Interest in the SRE approach is high. The Atomic Energy Commission has authorized ATOMICS INTERNATIONAL and the Southern California Edison Company to enter into an agreement for Edison to install electrical generating equipment with a capacity of 7,500 kilowatts adjacent to the SRE to convert the reactor's 20,000 kilowatts of heat into electricity which will be fed into the utility's power grid system. ATOMICS INTERNATIONAL and the



SRE reactor core is lowered into place deep in the Santa Susana Mountains

Consumers Public Power District of Nebraska are negotiating for the construction of a 75,000 kilowatt nuclear power plant utilizing a sodium graphite reactor based on SRE experience.

**The Sodium-Cooled,** graphite-moderated reactor design has many advantages. The use of sodium permits high temperature operation, good steam conditions and high thermal efficiency of power conversion without pressurization of the reactor and coolant circuit. The high thermal conductivity of sodium makes it an excellent heat transfer medium. Sodium boils at 1620°F.—is liquid at 208°F. This permits high coolant temperatures with the system at atmospheric pressure, creating a low-pressure heat extraction system which simplifies reactor construction. Further, the sodium design minimizes chemical reaction between fuel elements, coolants and structural materials—increases safety—allows the use of a variety of steels and alloys in construction.




Sodium Flow Diagram For SRE Cooling System

**Nominally Rated Output** of SRE with Uranium fuel (enriched with 2.80 atom percent U235) is 20 Thermal Megawatts. The reactor core is made up of fuel rods, moderator cans and control elements interspersed and immersed in sodium coolant. The fuel is composed of 6 inch slugs, 0.750 inches in diameter, formed in 6 foot columns tied in clusters of seven. The graphite moderator elements are canned in Zirconium, fabricated with an axial coolant channel. This prevents absorption of sodium into graphite. Much less costly than beryllium—graphite is also comparatively easy to handle.

**Capital and Power Costs in Full Scale Power Stations**—At present, with Uranium fuel, capital costs/installed Kw. are expected to total $300. With Thorium, costs may be $265/installed Kw. Power costs (based on 80% load factor and 15% annual fixed charges) may be 11 mills/kwh with Uranium, 9 mills with Thorium. Future costs with Thorium fuel are expected to be $200/Kw capital cost and 6.5 mills/kwh total power costs.

**Atomics International** is a major reactor builder—experienced in the design, construction and operation of nuclear reactors for research and the production of power. If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Applications Engineering Service, Dept. PE-N2, ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, California. Cable address: ATOMICS.


**ATOMICS INTERNATIONAL**
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

**For more data circle 546 on Post Card**

# boiler water levels now easier to **see**... easier to **read**

Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

Whatever the boiler pressure, high or low, YARWAY Remote Indicators give accurate, instant, eye level boiler water level readings at any convenient plant location.

Boiler Code Case No. 1155* says in part, "... two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi ..."

YARWAY Remote Liquid Level Indicators fill the bill—and feature a "wide vision" face that makes reading easier from any angle.

Accurate—because indicator is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum.

Also use YARWAY Remote Indicators on heaters of various types.

For full description, write for YARWAY Bulletin WG-1824.

*Write for free reprint of case description.

**YARNALL-WARING COMPANY**

100 Mermaid Avenue, Philadelphia 18, Penna.
BRANCH OFFICES IN PRINCIPAL CITIES

**YARWAY REMOTE LIQUID LEVEL INDICATORS**

For more data circle 547 on Post Card

# How Subsoil Affects Your Power Plant Foundation

**As power plants get heavier, location of the site assumes greater importance. However, increased knowledge of soil mechanics now available makes it possible to design adequate foundations for almost all types of substrata. Here are some specific examples**

**By M. ZAR***

NO OTHER PHASE of power plant design offers a greater challenge to the engineer than the determination of the proper foundations to use for given conditions. In modern steam stations, these conditions present many interesting problems — for example:

1. Equipment has grown larger and thus the loads to be handled have greatly increased over what they were a mere decade ago. Column loads of between 5,000,000 and 6,000,000 lb are occasionally attained;

2. The need for huge quantities of circulating water requires that the plant be near a large reliable water supply. This can pose difficulties, among them:

a. cofferdams, wellpoints, etc., are often needed during construction;

b. substructures must resist large hydrostatic forces;

c. structures must be designed against floating, especially during construction, before heavy permanent loads are added; and,

d. protection must be provided to prevent the inundation of operating areas during unusual high flood periods;

3. Foundation settlements must be kept to a minimum, since they can be detrimental to proper functioning of equipment; and,

4. Various types of equipment require foundations that must be proportioned to eliminate vibration.

Next, the foundation designer must resolve the above physical requirements in the light of what he has learned about the soil conditions at the site. The substrata, which he cannot examine except through small samples obtained from borings, must be analyzed, the proper level for founding determined, and the means for bringing the loads to this level selected. The modern science of soil mechanics has done much to increase the knowledge available to the designer for arriving at the safe allowable loads to use.

As an example of the application of core boring data to foundation determination, refer to Fig. 1, which is a typical soil log for a power plant extension on the shores of a lake. In all cores at the site, loose to medium sand was encountered to depths of from 9 to 23 ft, and very dense materials were found at a depth that averaged 33 ft below grade. This very dense stratum extended to a depth of from 80 to 90 ft. A layer of clay was encountered below the hard layer, with rock at approximately 130 ft down.

### Wood Pilings Selected

Although the hard layer at Elev. −26.7 ft is capable of carrying heavily-loaded spread footings, it was impractical to excavate to that level for this purpose, since the station has no basement. The foundations were carried, therefore, on wood piles which were jetted to Elev. −26.7 ft and driven about 2 ft into the dense layer. A load test determined that each pile could carry 25 tons safely (generally this is the upper limit for wood pile capacity). Since the bottom of the concrete pile cap would always be below ground water level, there would be no danger of the piles rotting out and creosoting was unnecessary.

Although the materials discovered at a depth of 80 to 90 ft are not usually considered acceptable for supporting heavy loads without settlement, the 50-ft thickness of very dense material above should distribute the superimposed loads without consolidation of the clay layer below them.

### Rock Problem

At another location it was thought, because of visible rock outcroppings at grade, that foundations would be relatively simple. It was felt, how-

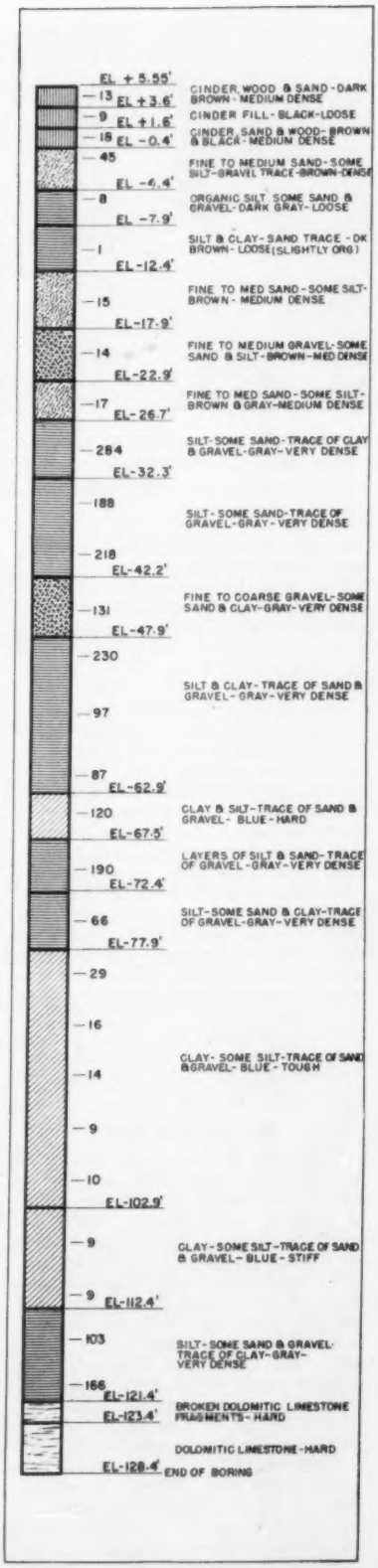

EL. + 5.55'
13
EL + 3.6'
CINDER WOOD & SAND - DARK BROWN - MEDIUM DENSE
9
EL + 1.6'
CINDER FILL - BLACK - LOOSE
18
EL - 0.4'
CINDER, SAND & WOOD - BROWN & BLACK - MEDIUM DENSE
45
EL - 4.4'
FINE TO MEDIUM SAND - SOME SILT - GRAVEL TRACE - BROWN - DENSE
8
EL - 7.9'
ORGANIC SILT, SOME SAND & GRAVEL - DARK GRAY - LOOSE
1
EL - 12.4'
SILT & CLAY - SAND TRACE - DK BROWN - LOOSE (SLIGHTLY ORG)
15
EL - 17.9'
FINE TO MED SAND - SOME SILT - BROWN - MEDIUM DENSE
14
EL - 22.9'
FINE TO MEDIUM GRAVEL - SOME SAND & SILT - BROWN - MED DENSE
17
EL - 26.7'
FINE TO MED SAND - SOME SILT - BROWN & GRAY - MEDIUM DENSE
284
EL - 32.3'
SILT - SOME SAND - TRACE OF CLAY & GRAVEL - GRAY - VERY DENSE
188
218
EL - 42.2'
SILT - SOME SAND - TRACE OF GRAVEL - GRAY - VERY DENSE
131
EL - 47.9'
FINE TO COARSE GRAVEL - SOME SAND & CLAY - GRAY - VERY DENSE
230
97
87
EL - 62.9'
SILT & CLAY - TRACE OF SAND & GRAVEL - GRAY - VERY DENSE
120
EL - 67.5'
CLAY & SILT - TRACE OF SAND & GRAVEL - BLUE - HARD
190
EL - 72.4'
LAYERS OF SILT & SAND - TRACE OF GRAVEL - GRAY - VERY DENSE
66
EL - 77.9'
SILT - SOME SAND & CLAY - TRACE OF GRAVEL - GRAY - VERY DENSE
29
16
14
CLAY - SOME SILT - TRACE OF SAND & GRAVEL - BLUE - TOUGH
9
10
EL - 102.9'
9
CLAY - SOME SILT - TRACE OF SAND & GRAVEL - BLUE - STIFF
9
EL - 112.4'
103
SILT - SOME SAND & GRAVEL - TRACE OF CLAY - GRAY - VERY DENSE
186
EL - 121.4'
EL - 123.4'
BROKEN DOLOMITIC LIMESTONE FRAGMENTS - HARD
DOLOMITIC LIMESTONE - HARD
EL - 128.4'
END OF BORING

Fig. 1. Test boring log. Numbers at the extreme left show relative resistance of the adjacent material to penetration

*Associate, Sargent & Lundy, Engineers, Chicago, Ill.

Fig. 2. Visible outcroppings of rock are not always reliable indications of good load-bearing substrata. Here, more than 170 test borings revealed no solid rock at reasonable depths

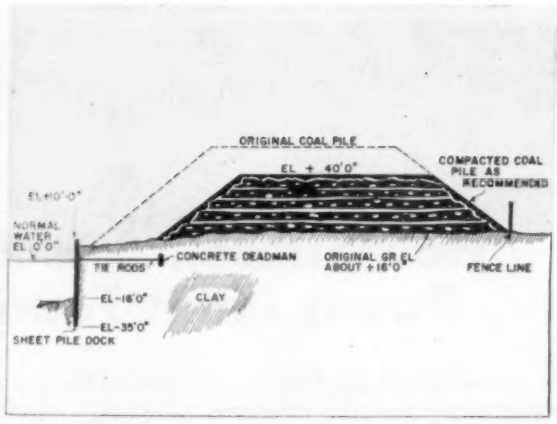



Fig. 3. Sketch of coal storage area on the shore of a lake. Coal pile weight had forced sheet-pile wall 16 in. outward; a study of subsurface clay in lab dictated new arrangement

ever, that subsurface exploration was warranted to avoid uncertainties.

Preliminary holes which were cored about 50 ft indicated that sound rock alternated with badly disintegrated rock, shale, and clay of greatly varying consistency from the surface to the full depths explored. The thickness of the materials and the depths at which they were encountered were so varied that it was not possible to establish a pattern upon which to base a satisfactory foundation design. Additional holes were drilled in an effort to define the weaker foundation areas, but this was not successful.

In an attempt to establish the possibility of supporting the heavy pier loads on solid rock (the heaviest load was 3,500,000 lb), cores were taken under each column. 170 additional holes, totaling 6600 lineal ft, were drilled and these borings verified the existence of many clay filled fissures and sink holes and much badly disintegrated rock under the areas investigated (See Fig. 2).

### Research Begun

Before the borings were completed in the boiler room area, intense research was begun on the possibility of drilling, economically, holes for concrete caissons, but the plans were all discarded, since an efficient machine for cutting large diameter holes was not developed, and sound rock for the most part was too deep to warrant expensive blasting or use of air tools. When the possibilities of caisson construction were exhausted, the only practical, economical foundation design in line with the subsurface information was to construct a thick concrete mat over the entire boiler room area. When the excavation for the mat foundation was completed, all loose material was cleaned off the subgrade so that bearing surfaces could be inspected. The designers surveyed the excavation and by means of jack hammers and wagon drills determined the extent of questionable load supporting areas. The foundation was designed to carry the interior column loads over clay-filled sink holes and fissures as determined from this survey, so that the loads were supported on rock. However, under some of the exterior columns, it was not feasible to carry the column loads by spanning the areas of the sink holes visible at the subgrade surface. The core borings indicated that sound load-supporting rock was located at a considerable depth below the bottom of the mat so that it would have been extremely expensive to sink piers to the rock. Since the clay in these areas was very hard and shale-like in character, and the column loads were relatively low, it was decided to support these portions of the mat on the clay at a maximum distributed bearing pressure of 4000 lb per sq ft.

### Sliding Dock

As an example of the application of soil mechanics principles, consider the following:

During the building of a coal pile alongside of a sheet-pile dock wall, it was observed that the dock piling had moved outward. The placing of coal was halted and surveys were made which verified that the steel sheeting had moved 14 in. Subsequent readings indicated continued movements until a maximum displacement of 16 in. was measured (See Fig. 3). At this point, a program of coal removal to within 60 ft of the sheeting was inaugurated and the dock movement was arrested.

Five core borings were taken along the toe of the coal pile and soil samples were tested in a laboratory. The tie-rods which were 10 ft below grade had been fastened to a continuous concrete deadman about 50 ft behind the dock. By excavation, this deadman was exposed for a length of 45 ft and surveyed for movement.

From laboratory tests and design calculations, as well as observed behavior of the deadman, it was concluded that the movement was surface-seated and was almost entirely limited to the soft clay layer that extended to a depth of about 10 ft from the surface and which originally had been placed as backfill over the tie-rods.

The natural water content and the confined compression strength of this soft clay stratum, as determined by the laboratory tests, indicated a low shearing strength for this clay which resulted in very low resistance to horizontal movement.

It was decided that a coal pile could be maintained safely at this location, provided that the top of the coal be limited to +40 ft and the south toe of the pile be kept to 40 ft from the dock.

The pile was built as recommended and readings have been taken periodically for the past two years, and there has been no measurable movement of the dock since.


**COAL STORAGE MANUAL . . .**
**Reprints Available**

REPRINT copies of POWER ENGINEERING 24-page Coal Storage Manual, which appeared first as a Special Feature in the March issue, are now available in limited quantities to interested readers.

Because the demand for these reprints exceeded expectations, an additional supply has been procured. Up to 2 copies will still be sent free of charge to any reader who requests them by addressing the Editor, 110 S. Dearborn St., Chicago 3, Ill.

Additional copies up to 12, $1.00 each; over 12, but less than 100, 20% discount; more than 100, write for prices.

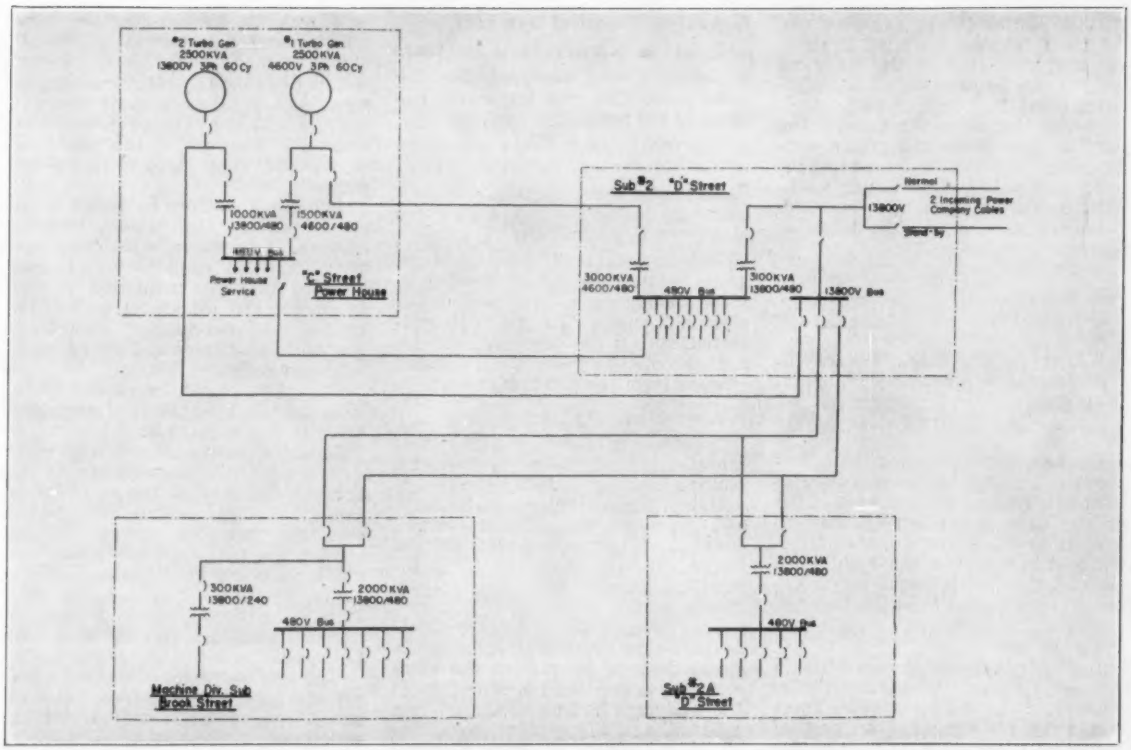



Fig. 1. Schematic diagram of electrical system showing incoming supply from the power company and generator circuits

# Back-Pressure Turbine Pays Off for Norton

**This installation saved $100,000 the first year. Here's an outline of the studies the company made before deciding there was economic justification for installing a back pressure turbine generator**

By R. G. MACINTYRE*

A MANUFACTURING company is not in the power business and usually has no desire to be. However, simple economics frequently dictate a decision to generate power. Steam used for heating and processing, if passed through a turbine first, might well pay for itself by reduced electrical cost. In addition, it is possible to achieve a degree of independence of Central Power Systems.

Such an installation of a turbine used to produce by-product power was recently made at Norton Company in Worcester, Mass. This by-product power is economical because part of the energy in the exhaust steam is used to produce power instead of being wasted in the condenser. After a year's operation, this installation is showing an annual saving of about $100,000.

A project of the magnitude that will produce such savings in a power plant needs a great deal of study and careful planning if expected savings are to be realized. This article will describe the original problem, the study made, and the eventual solution.

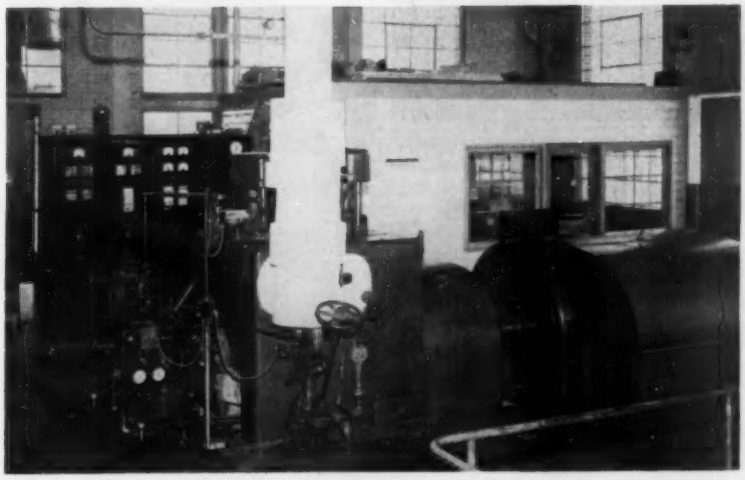


Fig. 2. View of the 2500 kw back pressure unit, which generates at 13,800 volts. The steam conditions at the throttle of the new turbine are 650 psig and 750F

*Superintendant, Services and Utilities, Norton Company

In the Norton power plant, a single 2500 KW turbine, installed in 1940, was supplying part of the electrical load for this large abrasive manufacturing plant.

During the years since 1940, the plant requirements had grown continuously. The electrical load had increased on all shifts, including weekends. Steam requirements were also increasing, as shown by the following figures:

| | 1940 | 1955 |
|---|---|---|
| Peak Steam Demand Per Hour | | |
| Winter | 80,000 lb. | 180,000 lb. |
| Summer | 40,000 lb. | 70,000 lb. |
| Peak Electrical Demand | 3,500 kw | 10,500 kw |

In the system set up in 1940, low pressure exhaust steam was distributed to a relatively small area of the plant. Steam at 125 psig was extracted at the sixth stage and distributed throughout the plant. The bulk of the low pressure steam demand was supplied from this line and the pressure reduced as required at the point of use.

Before making the decision to add a second turbine, a demand had to be created for the exhaust steam. There was some feeling that the cost of installing a low pressure distribution system for the 3 psig steam would defeat the project from an economic standpoint. Only a complete study could determine this, and it was based on these points:

1. Analyze all steam demand
2. Analyze all electrical demand
3. Cost of installation
4. Estimate of savings

**1. Analyze all steam demand:**

a. A survey was made of all equipment using steam. All data pertaining to demand, pressures, location and period of demand were correlated.

b. Load condition in (a) were compared with actual load demands for a period of one year.

c. Isolated locations of some equipment and the demand for low pressure steam was considered in relation to the cost of piping.

d. Calculations were made as to the amount of electrical energy that could be generated at all periods . . . providing the electrical demand was present.

e. Any possible use, either present or future, of low pressure steam, particularly during the summer months was thoroughly investigated.

Due to pressure requirements and pipe line pressure losses, it was decided that the low pressure steam distribution system would operate at 10 psig. This would change the water rate on the 1940 unit, a factor to be considered in figuring generating possibilities.

**2. Analyze Electrical Demand:**

a. Load charts analyzed for one year.

b. Demand was analyzed for the same year. This was important because of our power contract.

c. Electrical demand was compared with steam demand for the same year.

d. Any additional electrical demand contemplated in the near future was also given consideration.

The comparison of data on both steam and electrical demand provided the answer as to the amount of electrical energy that might be generated during the year and the expected reduction in electrical demand charges from the power company.

**3. Cost of Installation:**

To obtain a realistic estimate on a job of this kind, all major problems relating to design had to be solved.

One of these problems was turbine and generator size. The steam and electrical loads indicated a unit of larger capacity than the 2500 kw machine, which was finally purchased, could be used.

The deciding factor was economic as there were not enough peaks in the steam demand to warrant the extra cost of a larger turbine, even though 130 buildings had to be heated in a mile and a half long plant, subject to all the severity of New England winter weather.

Steam conditions at the throttle of the new turbine, 650 psi and 750 F, were the same as they had been for the 1940 unit. Electrical generating characteristics were changed. While the electrical output of the first unit was at 4600 volts, the new unit generated power at 13,800 v. It was estimated that this one change would decrease the electrical equipment and installation costs approximately $50,000. Figure 1 shows a schematic diagram of the electrical circuits including three of the seven substations.

Another departure in design from duplication of the present turbine unit was the decision to eliminate the sixth stage 125 psi extraction. It was believed that the reduction in demand for 125 psi steam made this installation unnecessary. This decision reduced turbine and piping costs approximately $30,000.

One of the most important problems was the layout of approximately 6,000 ft of low pressure steam main. This line is nearly all overhead construction, with one section of approximately 800 feet at the end of the line going underground in swampy area. As with the turbine size, a compromise with load conditions was made, resulting in the selection of a 12 in. line. The final design varied little from the original and pressure drops proved no greater than anticipated.

The final estimate of costs for the project approximated $500,000 and actual costs were within $3,000 of the estimate.

**4. Estimate of Savings:**

The savings estimate in electrical energy and demand charges was approximately $100,000 per year. A recommendation was made to management *continued on page 106*

Fig. 3. View of plant showing portion of 6000-ft low-pressure steam line

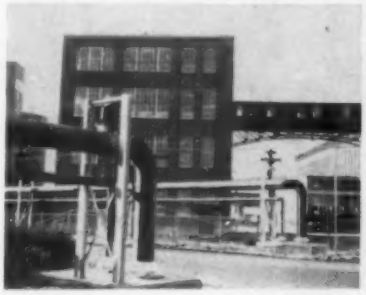


Fig. 4. Part of 6000 ft of 12 in. low pressure steam distribution pipeline

Fig. 5. Outdoor pipeline steam trap enclosed in cabinet to prevent freezing

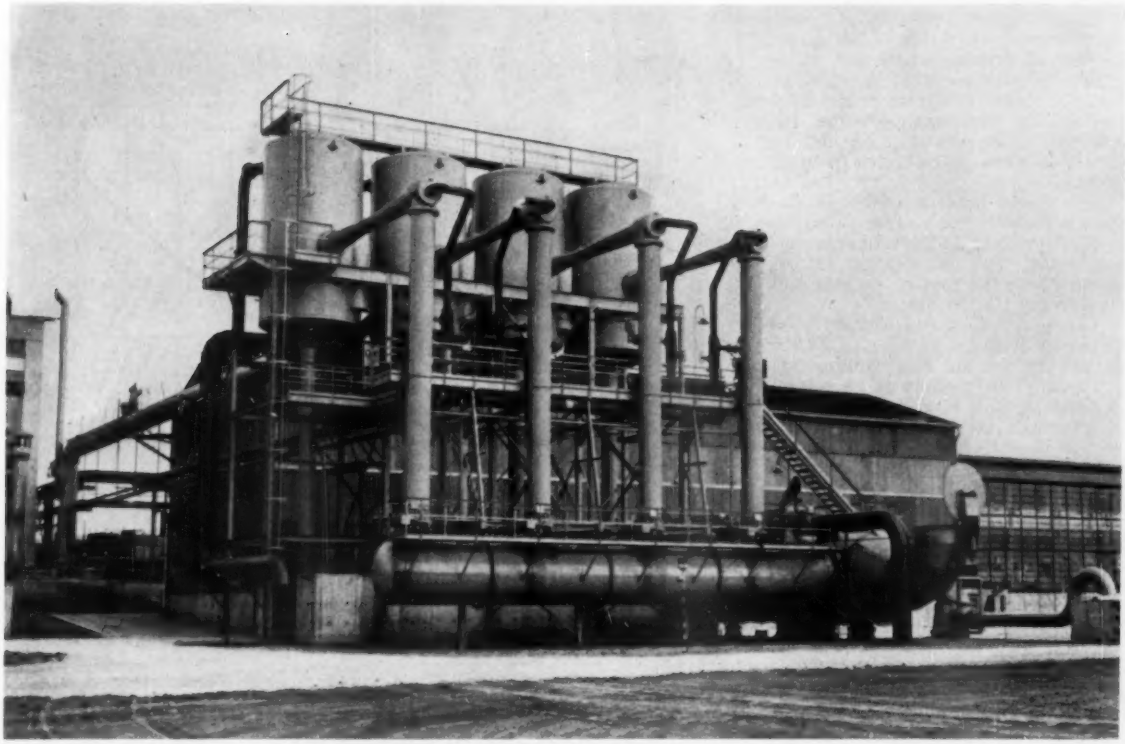


Fig. 1. One of the largest, this first-stage ejector in combination with two-stage barometric condenser handles test job

# Can Air-Operated Ejectors Solve Your Problem?

**Improved vacuum engineering techniques have advanced performance of air-operated ejectors; modern units can be made to function over wide ranges of loads and pressures. Here are some details**

By C. G. LINCK*

FOR MANY YEARS manufacturers have been marketing air-operated ejectors. These ejectors have by and large been of the "garden variety" type involving the more simple applications and without too much stress placed on the efficiency of the apparatus. We are speaking particularly of purge ejectors, liquid-moving ejectors, low-vacuum evacuation ejectors, and similar applications.

Today, however, the air-operated ejector is being considered for many applications and the efficiency of the unit has assumed prime importance. The aircraft industries, as well as several process industries, have begun to recognize the value of air operated ejectors, and in some instances, future installations will be made using air or a combination of air and steam as the motive fluid.

This article will concern itself with one such installation as well as some general data on air-operated ejectors.

To permit the reader to understand the function of an ejector, the principle of operation is given. See Fig. 2; the motive fluid, $P_1$, at a relatively high pressure is expanded thru a nozzle to a lower pressure, $P_2$, thereby converting its energy to velocity, and, in turn, entrains the load fluid

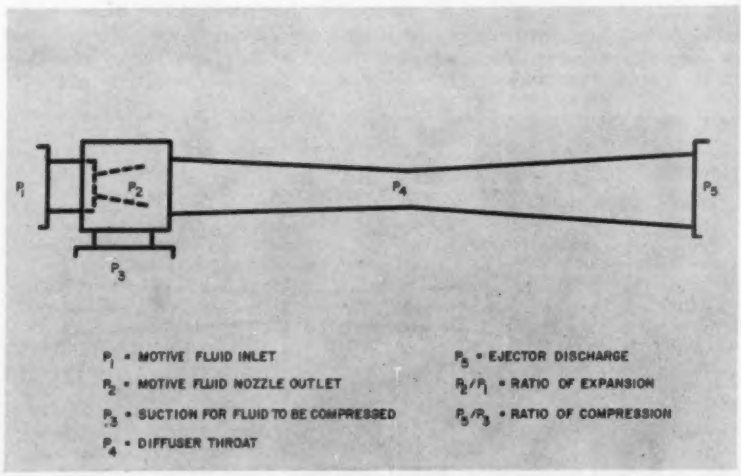



Fig. 2. Diagram of ejector; motive fluid at high pressure expands from $P_1$ to $P_2$, converting energy to velocity and entraining load fluid from low-pressure $P_3$

* Plant Manager, Graham Manufacturing Co., Batavia, N. Y.

from the lower pressure, $P_1$, and compresses both fluids to an intermediate or discharge pressure, $P_2$.

An air-steam operated injector has recently been designed, built and successfully performance-tested for installation in the altitude study facilities at a large eastern university.

This ejector is being used to evacuate air and/or combustion products in aerodynamic and combustion experiments. The installation is believed to be the first of its size and type in the United States.

The motive fluid consists of 13,500 lb per hr of water vapor plus 24,950 lb per hr of air and combustion products. The mixture is at a temperature of 1000 F, and at a pressure of 90 psia.

### Temperature Raised

To attain the high temperature mixture, the university takes air from mechanical compressors at 200 F, injects and burns hydrocarbon fuel in a specially designed burner, and raises the temperature of the gas mixture to approximately 3500 F. Water is then injected into the stream to cool the mixture to 1000 F, thereby producing the motive fluid specified in the previous paragraph.

Usually an ejector, regardless of its type of motive, is designed for one condition or for compressing over one range, such as from 24 in. Hg vacuum to atmospheric pressure. In the apparatus under discussion, however, the ejector is required to function over many compression ranges. Note curve in Fig. 3 which pictures the ranges covered. The manufacturer in this case guaranteed the entire curve yet maintained high ejector efficiency.

### Pressure Converted to Velocity

The design of the ejector is such that pressure energy is converted to velocity as previously stated. The first portion of the ejector is supersonic flow, the middle is sonic, and the latter part of the unit is subsonic. For the design under discussion, Fig. 4 shows Mach number encountered at three points of the unit. The Mach numbers are indicative only, since these will change for each particular range of compression.

Figure 5 shows the principal dimensions of the air-steam ejector as it left the manufacturer's plant ready for installation at the University's altitude test facilities. All dimensions are critical in nature and the shop or manufacturing technique must be of the highest standard in order not to sacrifice efficiency.

The materials of construction are listed below:

Motive Air Inlet — Forged Steel, ASTM — A-181
Suction Chamber — Flanged Quality Steel, ASTM — A-285, Gr. C
Air Nozzle — Stainless Steel
Diffuser — Flanged Quality Steel, ASTM — A-285, Gr. C.

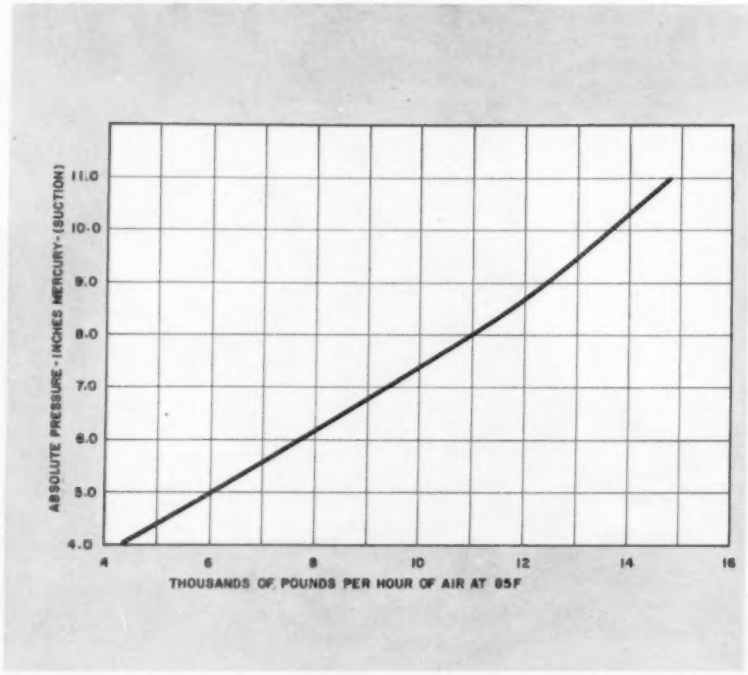



Fig. 3. Curve shows range of compression produced by an air ejector at a large eastern university. Most ejectors are designed to operate at one condition, and over relatively narrow range of compression; this unit functions over range above

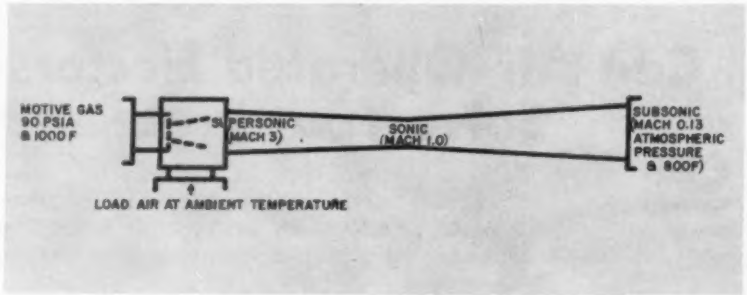



Fig. 4. Conditions existing in air ejector that has performance characteristics shown in Fig. 3. Motive fluid at inlet is supersonic, drops to sonic in throat, and to subsonic at outlet. Mach numbers typical of only one set of conditions

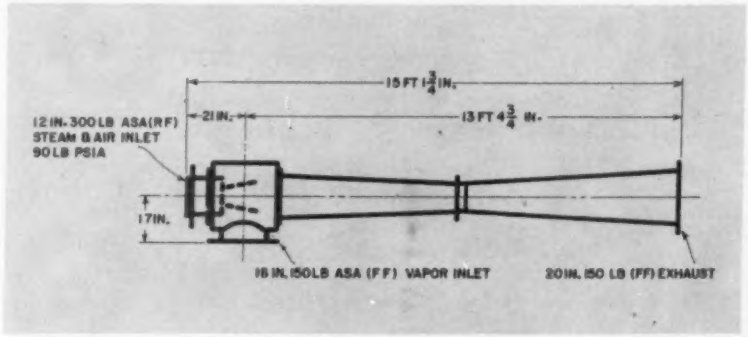

15 FT 1¾ IN.
21 IN.
13 FT 4¾ IN.
12 IN. 300 LB ASA (RF)
STEAM & AIR INLET
90 LB PSIA
17 IN.
18 IN. 150 LB ASA (F F) VAPOR INLET
20 IN. 150 LB (FF) EXHAUST

Fig. 5. Physical dimensions of ejector from Figs. 3 and 4. Dimensions are very critical, but performance is not matter of simple geometry; while theory is well known, actual design of this equipment requires experience with its intricacies

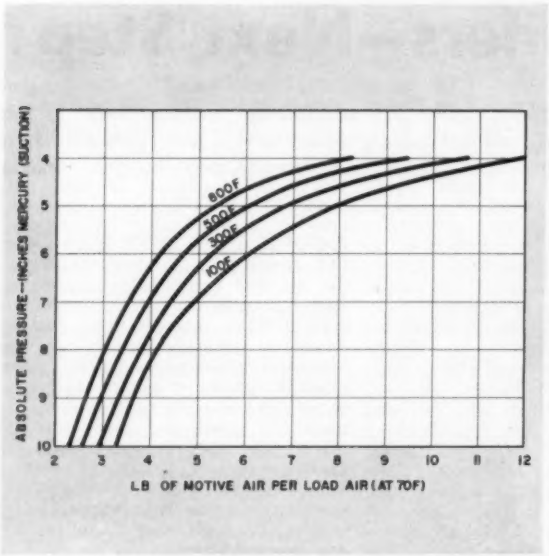



Fig. 6. Air ratios: various vacua at various temperatures; note decrease in motive required as temperature increases

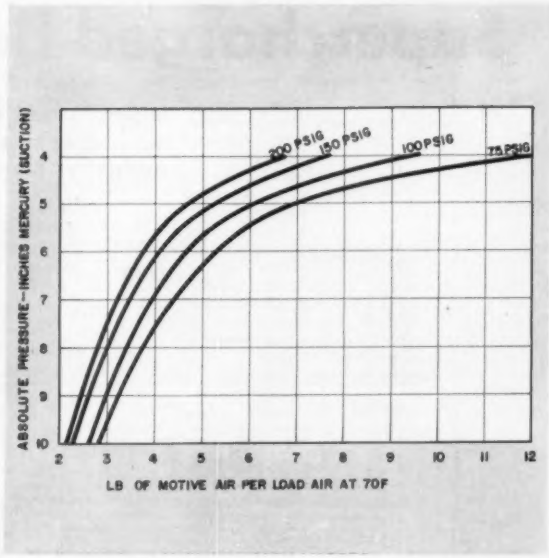



Fig. 7. Ratios obtained for various air pressures when the propellent temperature is constant; note motive pressure

A liberal allowance for corrosion is added to the thickness required for pressure and vacuum service.

Referring to Fig. 2, a few general remarks will be of assistance to the engineer who is considering the use of air-operated ejectors for his facility.

### Points to Consider

1. As $P_1$ increases in pressure, the amount required to perform a specified duty is decreased.

2. As $P_5/P_2$ increases, the amount of $P_1$ fluid increases. There is, however, no direct relationship between increasing $P_5/P_2$ and the extra motive required. For example, if we consider compressing from 8 in. Hg abs to 30 in. Hg abs, $P_5/P_2 = \frac{30}{8} = 3.75$. From Fig. 3 we note that the amount of motive required for each pound of load $= \frac{38400}{11000} = 3.49/1$. Then if we compress from 4 in. Hg abs to 30 in. Hg abs, $P_5/P_2 = \frac{30}{4} = 7.5$, so one might conclude the ratio would be $\frac{7.5}{3.75} = 2 \times 3.49 = 6.98$. However, from Fig. 3 we can readily see the ratio is $\frac{38400}{4300} = 9.0/1$. In other words, increasing the compression ratio merely indicates that the amount of propellant required will also increase, the extent of which can only be determined by detailed calculations or by actual test.

3. $P_2$ and $P_4$, the nozzle mouth or outlet and the diffuser throat are of first importance to performance. While the theory necessary for calculating the ejector is reasonably well-known by some manufacturers, the actual ejector deviates considerably from the theoretical. There is no mathematical answer for the deviation and therefore engineers interested in air- or gas-operated ejectors should refer their problems to experienced manufacturers of this type of equipment.

Referring to Fig. 6, it will be noted that air ratios for various vacua at various temperatures are plotted to picture the decrease in motive required as the temperature of the motive increases. The pressure of the motive air remains the same for all temperatures listed.

The reader will note that Fig. 6 does not show air temperatures beyond 800 F. This is because any further increase in air temperature (using 100 psig) will *not* decrease the amount of motive or propellant required.

This is caused by the fact that as the temperature of motive fluid is increased, two things occur. First, the velocity of expansion increases, but at the same time the duty required for compression increases. When the increase in compression duty offsets the advantages of the higher temperature motive, the "point of no return" has been reached.

### For Each Pressure, a Temperature

This means that for each air pressure there is one temperature which will yield maximum results. Some variation in best temperature for a particular motive pressure will exist since the compression ratio also plays a part in determining the most efficient temperature for any selected motive pressure.

It is further true that the load temperature will influence the selection of the most efficient motive temperature for any given motive pressure.

Figure 7 shows the ratios obtained for various air pressures when the propellant temperature is held constant. The effect of this curve is to point up the importance of the motive pressure as well as the motive temperature and other points that have been discussed.

Naturally, high-pressure air is extremely desirable, but it is many times possible to increase the air temperature and achieve the desired results even though the air pressure is moderately low.

### Information Needed

In considering air, air-steam, or gas-operated ejectors, the engineer needs to know the following properties and conditions:

Motive pressure
Motive temperature
Motive molecular weight
Motive specific heat
Motive specific gravity
Load Suction Pressure
Load Suction Temperature
Load Molecular Weight
Load Specific Heat
Load Specific Gravity
Ejector discharge pressure. (Particular care should be taken to add to the discharge pressure any pressure losses anticipated from the ejector proper outlet to the final point of discharge.

In the months and years ahead, the engineer will see more and more use of the highly efficient and economical air- or gas-operated ejector. The initial cost is frequently lower than other types of vacuum producing apparatus, and the cost of obtaining high temperature motive is usually incidental to the project. Also, the operation of an air operated ejector is much quieter than ejectors motivated by steam. Like steam operated ejectors, there are no moving parts, hence maintenance costs are negligible and operation is trouble free.

# Supercharged Boilers—Next Step?

**Supercharged boilers, unlike the souped-up vehicles dear to the hot-rodder's heart, are not merely conventional units with attached gadgetry; they are specialized units for utilizing the gas turbine**

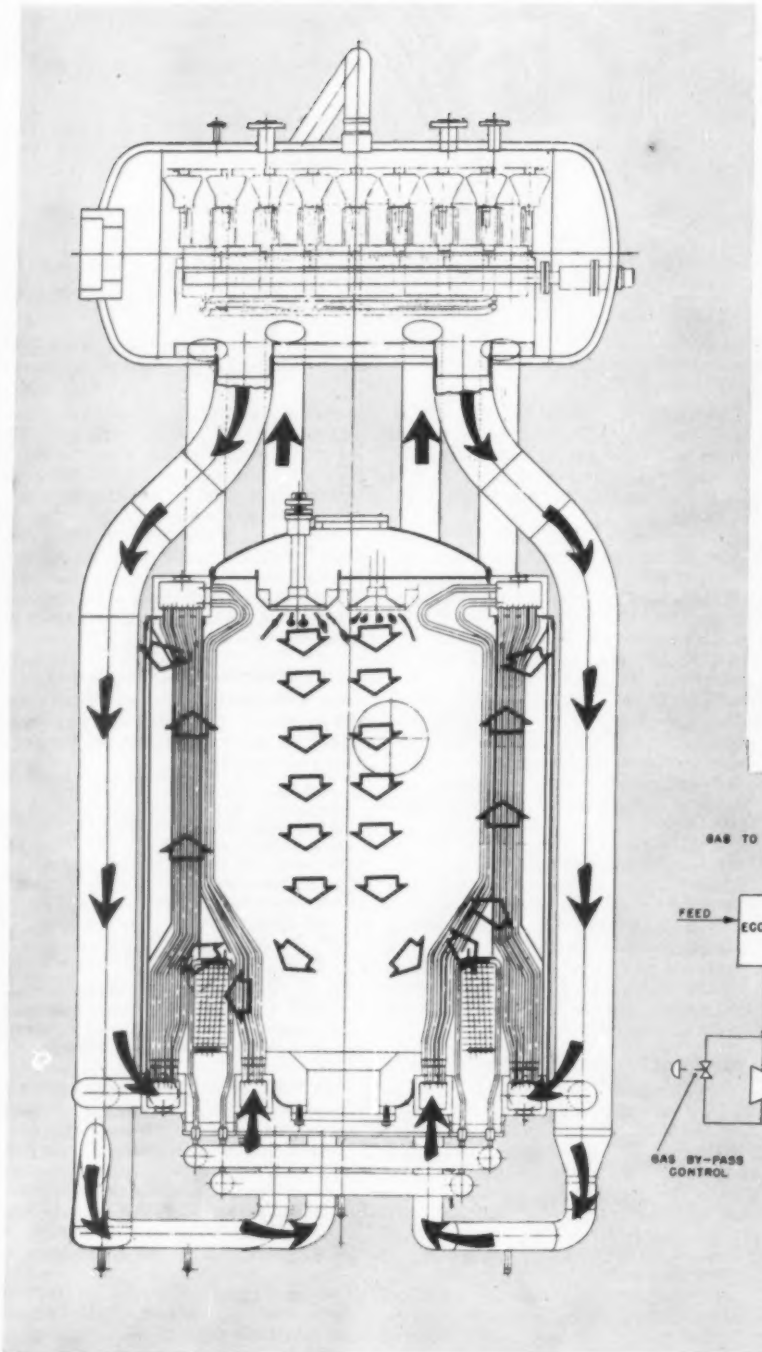


Fig. 1. Cross-section shows general design of supercharged boiler. Outlined arrows show combustion gas flow; water and steam flow are shown by solid arrows

MUCH INTEREST HAS arisen recently in the possibilities of the various combined gas-turbine/steam-turbine supercharged-boiler cycles. This interest was demonstrated at the American Power Conference at Chicago in March; a significant number of papers were read on several aspects of this development. Of particular immediate interest was the talk delivered by Daman and Zoschak of Foster Wheeler, who released details of that company's work with supercharged boilers. The highlights of their paper* are discussed here.

There are really two types of supercharged cycles — the *self-sustaining cycle* and the *power cycle*. The self-sustaining cycle, shown schematically in Fig. 2, utilizes flue gases to operate a gas turbine which drives a compressor to furnish air to the boiler. With this cycle, there is no net gain in power output or efficiency except for that resulting from elimination of power requirements for the draft fans. There is, however, a saving in first cost as compared to conventional plants, and some advantages in size reduction (Fig. 3).

* *Supercharged Boiler Design, Development and Application*, by Ernest L. Daman and Robert J. Zoschak. To obtain a copy of the complete paper, write to the Editor or use the postcard.

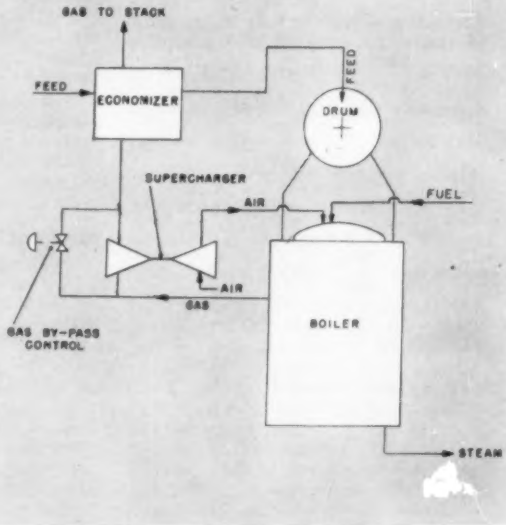



Fig. 2. Supercharged, self-sustaining combustion cycle; no power generation

The so-called power cycle, on the other hand, uses the gas turbine not only to drive the air compressor, but also to drive a generator which itself produces power. This additional generation — at high gas temperatures — improves cycle efficiency significantly. A typical power cycle for a 43,000-kw plant is shown schematically in Fig. 4.

The supercharged boiler, like the conventional boiler, varies in arrangement and design for different sizes, fuels, applications, and steam- and gas-side conditions.

Specific heat absorption in the supercharged boiler furnace is higher than that in a conventional furnace. Although absorption rates up to 450,000 Btu/hr/sq ft projected furnace envelope have been realized in some units, it appears that, for economic and arrangement considerations, the furnace absorptions will be of the order of 200,000 Btu/hr/sq ft projected furnace envelope.

The convection section arrangement of the supercharged boiler is also, in general, subject to the same considerations as that of a conventional boiler. However, if the pressure-fired boiler is designed to have pressure gradients across the heating surfaces equivalent to those of a conventional boiler, the mass flows and heat transfer coefficients will be higher than those in the conventional boiler. Hence, less surface is required for the convection section of the supercharged boiler.

A typical design for the supercharged type of boiler is shown in Fig. 1. This particular unit was designed for a self-sustaining cycle. It has a steaming capacity of 150,000 lb/hr at 1200 psig, 950 F, with boiler exit gas temperature of 820 F and turbine exhaust temperature of 480 F.

The power cycle system in Fig. 4 utilizes a supercharged boiler with a capacity of 280,000 lb/hr at 1250 psig, 950 F, with 225 F feedwater entering the economizer. The gas turbine receives gas at 1450 F and generates 6500 kw. Expansion ratio through the gas turbine is about 6 to 1. Some full-load performance figures are listed in the table.

Development of the supercharged boiler is still not complete in all its aspects, and much remains to be done — particularly in fuel adaptability. At the present time, use of these boilers is restricted to areas where natural gas is abundant and competitive in price. There is reason to believe that current progress in treatment of Bunker C for use in gas turbines will eventually solve the supercharged boiler problem as well, but these units will not realize their widest application until practicable methods of firing them with coal have been developed. One possibility is the design of a simple, reliable, and efficient gas producer which will not add materially to capital investment; another is the firing of coal directly into the furnace, with suitable means of removing ash and slag — a difficult design problem in a pressurized unit.

In any event, the supercharged boiler may play an important part in future steam generation, and — one way or another — the problems it poses will eventually be solved.

Table of full-load performance figures for a typical supercharged boiler such as that in Fig. 4; fuel is natural gas

| | |
|---|---|
| Steam flow (lb/hr) | 278,000 |
| Superheater outlet pressure (psig) | 1250 |
| Superheater outlet temperature (F) | 950 |
| Total air flow (lb/hr) | 348,000 |
| Boiler air flow (lb/hr) | 340,480 |
| Afterburner air flow (lb/hr) | 7520 |
| Air pressure (psia) | 86.0 |
| Air temperature (F) | 503 |
| Excess air (per cent) | 10 |
| Total fuel flow (lb/hr) | 21,476 |
| Boiler fuel flow (lb/hr) | 21,014 |
| Afterburner fuel flow (lb/hr) | 462 |
| Gas leaving afterburner (F) | 1450 |
| Gas flow to turbine (lb/hr) | 396,476 |
| Net heat release per cu ft furnace volume (Btu/hr) | 685,000 |
| Furnace radiant heat absorption per sq ft projected surface (Btu/hr) | 211,900 |
| Temperature of gas leaving radiant furnace (F) | 3020 |
| Furnace exit screen heat absorption (Btu/hr-ft²) | 126,000 |
| Temperature of gas leaving exit screen (F) | 2750 |
| Superheater heat absorption (Btu/hr-ft²) | 107,000 |
| Temperature of gas leaving superheater (F) | 2080 |
| Convection screen heat absorption (Btu/hr-ft²) | 37,800 |
| Temperature of gas leaving convection screen (F) | 1960 |
| Main convection section heat absorption (Btu/hr-ft²) | 65,000 |
| Temperature of gas leaving convection section (F) | 1400 |

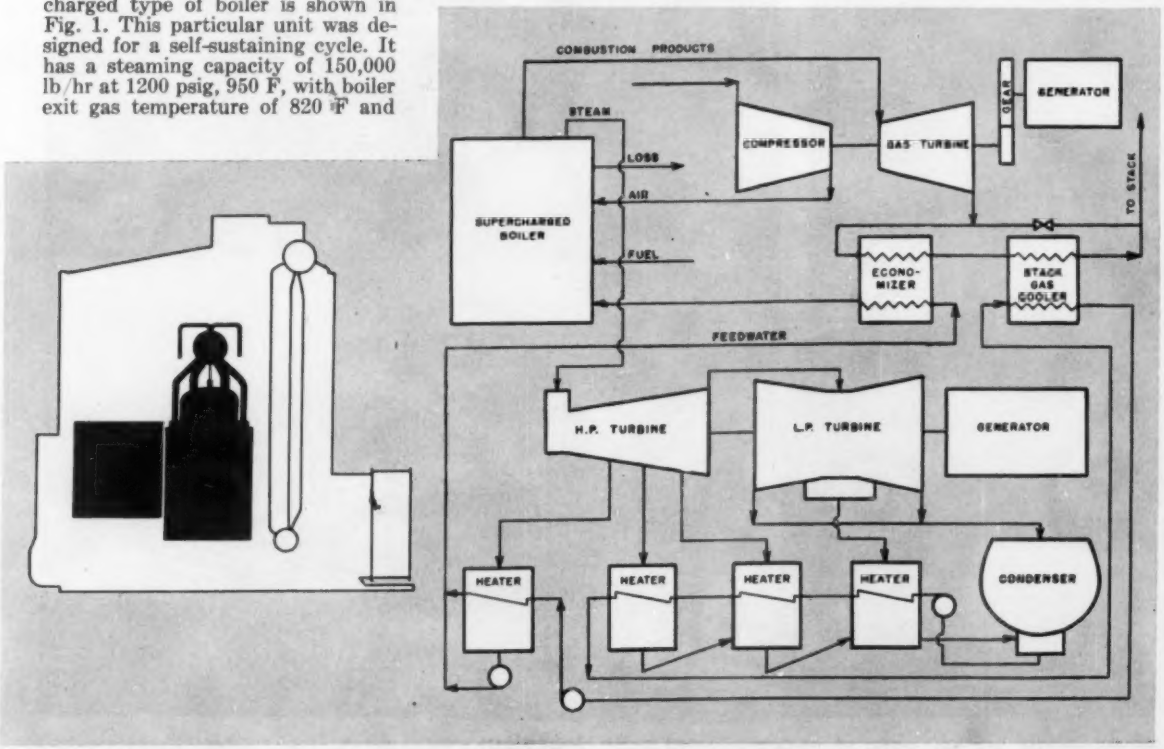



Fig. 3. Comparison of a supercharged and conventional boiler, same capacity

Fig. 4. Diagram of a 43,000-kw supercharged power cycle. Combustion gases drive gas turbine which powers 6500-kw generator as well as air compressor

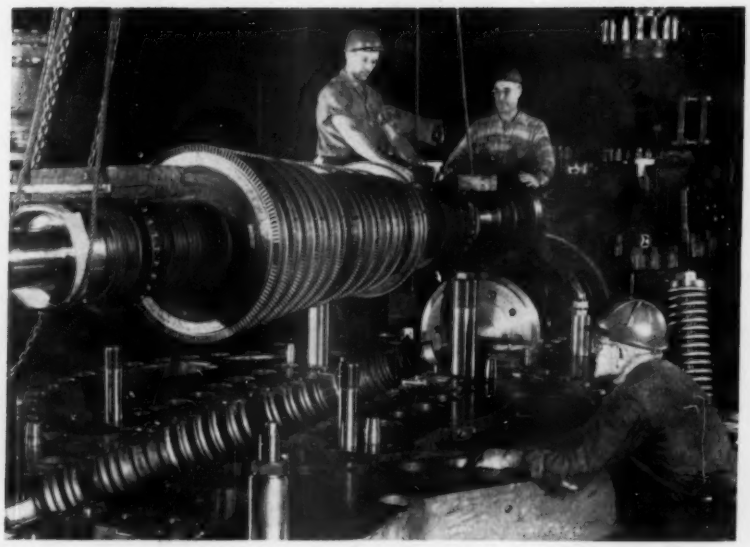
# News Reel

**When a boiler** broke down recently at the Lunkenheimer Co. plant, the Baltimore & Ohio Railroad lent a steam locomotive to serve as an auxiliary power plant. This coöperation enabled the company to keep running until their own boiler had been repaired

**Draw-string 'parka'** made of neoprene-coated nylon used by M. W. Kellogg Co. to prevent weather stopping chimney construction. Parka was moved up as work progressed

**Ingenious way** of moving large numbers of concrete drain pipes quickly over building site. Pipes are carried on three special 36 in. forks bolted to bucket of I-H Skid-Shovel

**Console sections** of General Electric Co.'s automatic load dispatching system. This control system automatically adjusts station output to suit continually fluctuating consumer load



**Turbine spindle** for world's first supercritical pressure steam turbine generator being lowered into its shell at G-E's Schenectady plant. Unit will operate at 4500 psig and 1150F and will be installed this year in A. G. & E's Philo station

**Group of man-made** industrial diamonds presented by G-E to Smithsonian Institution compared with Rockwell hardness tester. Though man-made diamonds have been made before, this is the first time reproducibility has been achieved

**Gamma ray projector** for radiographing pressure vessel welds in use in M. K. Kellogg Co.'s plant. The projector is on fork-truck while the film is being attached to the outside of the vessel

# Paper Mill and Utility Interconnections Raise and Solve Problems—I

**This article, the first of three, discusses the reasons for installing a utility tie, switchgear problems with the tie, capacity of the tie, and the control and operation of a mill's turbine generators before and with the tie**

**By H. A. ROSE * and H. E. SPRINGER †**

DEMAND for electric power in modern pulp and paper mills is increasing faster than the demand for thermal power. In consequence, the electric power that can be generated by normal process steam is becoming inadequate. Low cost hogged fuel and mill waste are also no longer available in abundant quantities to generate the increasing unbalance in electrical load with condensing steam.

Mill operators are therefore finding it more economical to purchase a portion of their electric energy from utility power systems rather than operating their own generating equipment on more expensive fuels and with consequent heat loss to the condensing water.

This requires interconnection between mill and utility for joint or parallel operation, for which Figs. 1 and 2 represent typical arrangements. The power tie often requires major modifications in the mill electrical system. New problems and methods of plant operation are usually encountered.

Total cost to the mill for a major utility connection is usually considerable. Final cost estimates are often much higher than anticipated during initial investigation. Appreciation of the more important factors of installation and operation of such power ties is therefore desirable.

Most important points for the mill to consider are:

1. The interconnecting power circuitry shall be large enough to ensure continuity of service to the mill's principal product producing departments.
2. The interconnection shall be made at minimum initial cost commensurate with the mill's needs for circuit flexibility and future growth in load.
3. Such changes as may be required in the mill's internal power distribution system shall be made at minimum cost commensurate with continuity of service and safety to equipment and personnel.
4. That the flow of electric energy to the mill may be controlled to obtain minimum cost rates under terms of the power contract.
5. That fault conditions within the utility circuits shall be relieved or disconnections made so that prime mill processes are not adversely affected.
6. The resulting system shall operate economically and efficiently in all its principal parts.

**Relationship of Electric and Thermal Power:** Principal reason that mills purchase power is one of economics: namely, a portion of their electric energy may be purchased for less cost than would be required to generate it.

Availability of reliable low cost power has had profound influence on the quantities that mills consider it safe and economical to contract for. To be of most value, purchased power must be reliable and have good voltage regulation at the delivery point to the mill. The power system should be capable of paralleling the normal growth of mill power.

Mills require large amounts of process heat energy in the form of low pressure steam. In the United States this energy is generated by fuel fired boilers. It is unlikely in the foreseeable future that this energy can be economically purchased as electric energy even though highly efficient electric boilers are available for heat conversion. It should be recognized that utility electricity (except in the form of heat) cannot serve the thermal processes of the mill. Heat energy must be generated by burning mill waste or purchased fuel of some kind.

Electricity, as a utility product, can, however, fulfill the energy requirements for all the mills' wheel turning and mechanical power-consuming machinery.

It is important to recognize that most pulp and paper mills do have fairly large-size electrical generating plants and find it economical to operate them. This is because the cost of adding electric power generation to the already required steam boiler plant is small enough to make it economical to generate the full amount of electric energy required by the mill. Mill waste and low cost hogged fuel enable steam to be produced very economically.

This is accomplished by boilers and generating equipment designed to operate in conjunction with the mill's processes but at elevated temperatures and pressures, — being augmented by steam superheating and condensing equipment. In this way the normal flow rate of process steam generates a large portion of the mill's electric power. If more electric power than this is required to turn the mill, the additional amount must be generated by steam flow to the condenser. If this increment has been generated by waste fuel, a satisfactory heat balance can be assumed, or conceivably the mill might have an excess of electric power for sale. If there is a deficiency of waste fuel to balance electrical requirements, fuel oil (or other type fuel) will have to be burned in proportionate amounts and at comparatively high cost. It should be recognized that heat liberated at the condenser is lost.

It is at this point in the balance of economic factors that the utility may be able to offer sufficiently attractive rates for specific amounts of electric energy. That this balance point has been reached is evidenced by the large number of pulp and paper mills that purchase all or a substantial portion of their electric energy.

**Power System Layout and Switchgear Requirements:** Many papers [1] have been written on electric power systems for industrial plants. It is not within the scope of this article to discuss types of systems specifically applicable to pulp and paper mills. However, the power system for a properly laid-out mill will most generally use one or a combination of the

* Consulting and Application Engineer, Westinghouse Electric Corp., Seattle, Wash.

† Electrical Superintendent, Rayonier Inc., Port Angeles, Wash.

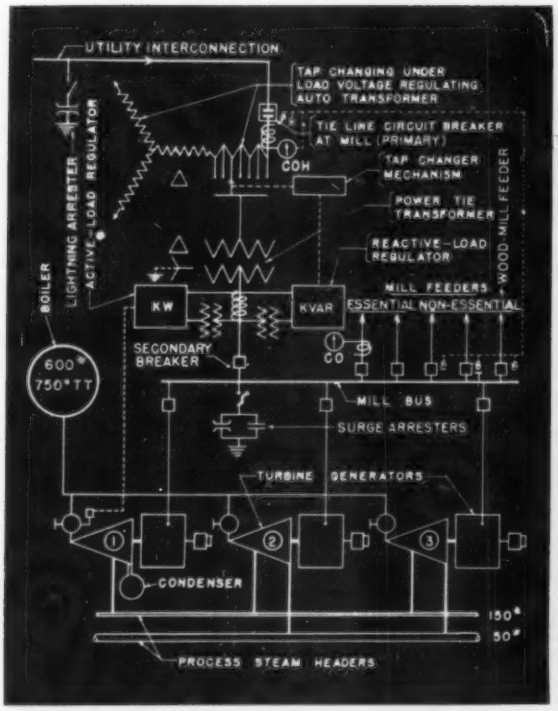



Fig. 1. Schematic diagram showing a typical tie line interconnection between a utility and a paper mill power system

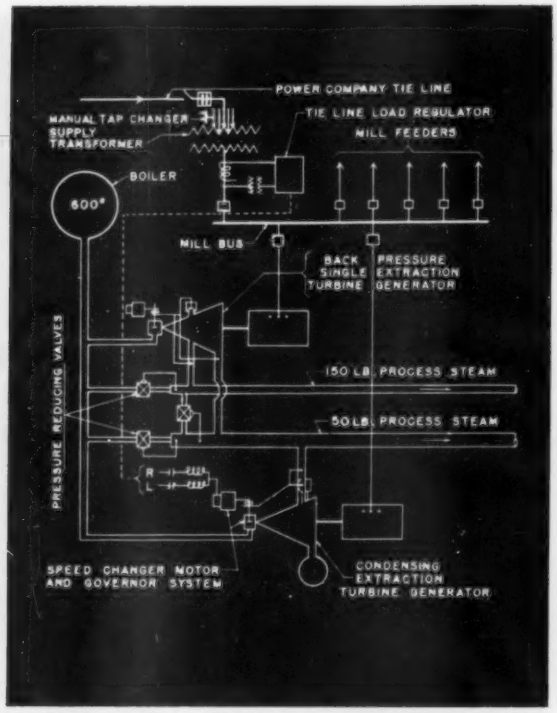



Fig. 2. Typical pulp mill system showing a utility tie, the kw and kvar control regulators and the high speed tie trip relays

following types, feeding from the principal sources of supply, to step down load center transformer stations near centers of load in different departments of the mill:

1. Simple radial feeders,
2. Simple loop feeders.

A utility tie will not usually require changes in the distribution system if it is of modern load center design. If not of such design, major changes will likely be required to insure process power reliability, and safety to equipment and personnel.

A strong power tie is very apt to require major modifications in engine room power circuitry and switchgear. These may entail replacement of old circuit breakers with new equipment having adequate short circuit interrupting ratings to meet the increased duty.

It is important to understand why costly plant modifications may be required, so management can be properly informed and adequate funds provided. A few principal factors are usually responsible:

1. Addition of a new source of power in parallel with existing generators may increase the internal short circuit capacity of the mill's circuits so that higher fault capacity circuit breakers are required, even though the tie may involve no increase in mill load.

2. The mill's switchgear may have inadequate fault capacity for the existing plant if additional generating capacity has been added without proper corrective measures being taken at the time this capacity is added.

3. An isolated turbine generator plant (or one having a weak power tie) when subject to short circuit will rapidly diminish its fault current output. By the time existing slow-speed circuit breakers open their contacts, the fault interrupting requirement of the system has decreased to comparatively low value, thus minimizing the duty imposed. When such a plant is connected directly with a strong power tie, the tie does not diminish its fault current output with time. In such cases, existing switchgear may be entirely inadequate for the new conditions. Figure 3 is a typical illustration showing the increased short circuit interrupting requirements produced by a strong utility tie.

4. Other deficiencies of existing switchgear may be:

a. Inadequate momentary current-carrying capability under fault conditions,

b. Inadequate current-carrying capacity for normal loads,

c. Inability to completely close in against the worst fault,

d. Old obsolete design, manually operated, unreliable.

It should be clarified that there is nothing fundamentally wrong to take advantage of the inherent fault decrement characteristics of alternating current generators to make continued use of old slow-speed but otherwise satisfactory switchgear when this can be properly done. It is this characteristic, coupled with intentional time delayed relay settings that has been responsible for years of very satisfactory and safe performance of many circuit breakers in older mills.

This procedure should be taken only after a careful power system study is made and with the knowledge that provisions must be set up to insure that the protective relay system as well as the characteristic of the breakers are understood, and this equipment properly maintained by the operating force.

A detailed engineering analysis of the mill's power system should be made to determine the proper equipment and layout of circuits required for any power tie. Such studies produce best results when made in close coöperation with the mill's engineering personnel.

**Capacity of the Power Tie:** The power tie will usually be made through a supply transformer, for stepping the utility voltage down to one of the mill's principal bus voltages. For mills having more than one voltage (other than 480 volts), the tie will usually be made to the bus of highest voltage.

Normal tendency is to size the transformer to meet the immediate contract load. It is well, however, to consider near future power requirements and size the transformer and primary circuit breaker accordingly. This point is of particular importance if the mill is to provide the connecting equipment. Otherwise, installation of undersize equipment will later result in complicated and expensive switch

structure additions. The power supply station for a mill should always be of simplest design with numbers of insulator strings, bus supports, disconnecting switches, and other devices that can collect deposits from mill fume reduced to a minimum. The best way to avoid trouble with such devices is to eliminate them by design.

Regardless of the tie capacity decided on, serious consideration should be given to the future probable transformer bank rating. Based on this rating, the secondary power circuit arrangement and fault interrupting capacity for the mill's main bus switchgear should be determined. Attention to this important matter will obviate the necessity and embarrassment of having to make expensive corrections at some early future date.

**Operation of the Mill's Turbine Generators Prior to a Utility Tie:** The isolated mill in addition to producing its process steam and electric power must also maintain its own 60 cycle plant frequency. A typical mill might have two generating units (Fig. 1). One could be a single extraction, back pressure unit; the other, a single extraction, condensing unit. Since process steam flow rates are quite variable, this steam in passing through the turbines generates proportionately variable power. Since electric load requirements are also variable and bear no fixed relation to process steam demands, there will be times when the total kw of electric load will exceed process steam capability. At other times process steam capability may exceed electric load requirements. It is obvious that continuous ideally balanced operation is unattainable.

To provide for this disproportionate relationship, mill turbines are equipped with elaborate steam flow and speed governor controls. [2 3 4] At least one unit will have a steam condenser. Automatic pressure reducing steam flow valves will be installed between boiler pressure and the process lines to supplement turbine flows as illustrated by Fig. 2.

The condensing unit (Fig. 1) would be used to establish mill frequency, it being set on speed governor control to hold 60 cycles. The other unit would run in synchronism as a non-speed regulated machine generating power in proportion to process steam flow through it. Both turbines would be arranged with extraction and exhaust process-pressure-regulators, adjusted for parallel steam flow operation according to process needs.

When process steam requirements are in balance with electrical load, the extraction and exhaust pressure controls will adjust steam flow rates through sections of turbine blading so that proper process line pressures are maintained. In this case, there will be no flow through the reducing valves and there will be no steam (except for a small amount of cooling steam) passing to the condenser.

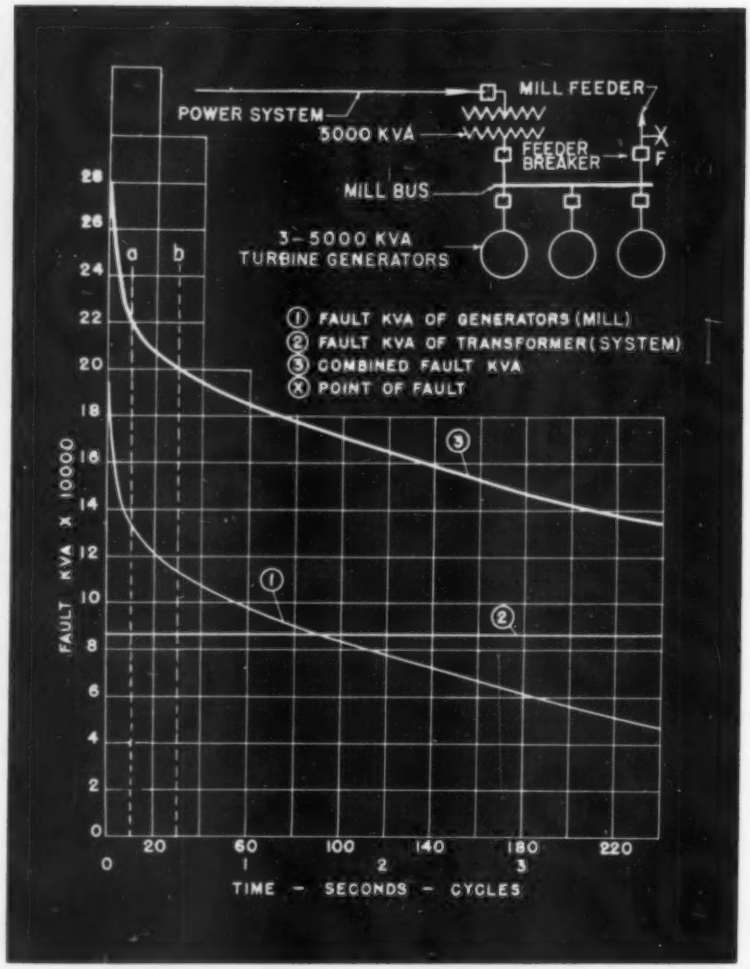



Fig. 3. Shows how a utility tie increases the fault kva on a mill's power system

Should electrical load demand exceed equivalent process steam requirements, the frequency will lower slightly. This affects the speed governor of the condensing unit which actuates the turbine's control valves admitting additional steam to re-establish frequency and to generate the increased load. The increased flow results in essentially instantaneous automatic re-adjustment of both turbines' extraction controls so that the excess steam required to generate the additional electric load passes to the condenser. The extraction pressure remains constant because the extraction servo-motor will operate to compensate for the increased steam flow by passing it on to the condenser.

Should electric load demand be less than equivalent process steam requirements, the frequency will rise slightly, affecting the speed governor and associated control valves to reduce steam flow. The decreased flow lowers process line pressures which opens the pressure reducing valves to make up the deficiency direct from boiler pressure.

Different types, combinations and numbers of turbine generator units will be used to meet different mills' processes and power requirements but the underlying fundamentals of operation will be essentially the same as described.

**Operation of the Mill's Turbine Generators with a Power System Tie:** The generators of the non-isolated mill must run in synchronism with the utility. Since the generating capacity of the power system is usually large compared to mill capacity, and is regulated at essentially constant frequency, the mill's turbine speed governors have no control over system frequency. Their frequency-controlling ability is lost at the instant of synchronization.

If, at the instant of synchronization, both systems are running at exactly 60 cycles, there will be no interchange of power, but the turbine governors will instantly lose all ability to control speed — in fact, there is normally no system speed change to affect them. If a system speed (frequency) change does occur, the

turbine governors will be affected and any units that are set for speed regulation in this frequency range will experience decided changes in steam flow and load.

If the system frequency rises slightly, the governors on speed control will reduce steam flow, unloading the units. A reduction in system frequency will increase load on the same units. The effect is very pronounced. For example, a 1 per cent system frequency change might change load on any of the mill's speed-regulated units about 25 per cent, but the utility would experience only about 1 per cent load change.

Again, assume there is no power interchange at the instant of synchronization. If now the mill load increases, the utility will absorb the entire increment since there will be essentially no frequency change and, consequently, no governor action to increase steam flow. Fluctuations in mill load will result in equal fluctuations in utility load but the output of the mill's generators will remain unchanged. A decrease in mill load from the initial value assumed (zero interchange) results in reversal of power in the tie, so that the mill generators help carry the external system load.

It is common to say that the mill generators carry a portion of mill load or some additional portion of the utility load. Actually, they assume a portion of the total system load in proportion to their torque energies.

If the utility maintains normal frequency, it can exercise no control over the power taken by the mill. The magnitude and direction of power flow in the tie can be determined and regulated only by the prime movers of the mill's own generators. To change the load generated by these units requires:

1. A change in process steam flow as initiated by extraction and back pressure controls. (Applies primarily to extraction and back pressure machines not on speed governor control.) Since process steam flow rates are governed by process requirements, noncondensing extraction back pressure machines are not often used for load regulating purposes.
2. A change in adjustment of the speed changer mechanism (speed governor setting) so that for the same system speed, more steam is admitted by the governor control valves. (Applies primarily to condensing or other machines operating on speed governor control.)

The foregoing data were adapted and rewritten by the authors from a recent AIEE paper. In a future article, they will cover mill power operation.

### References


[1] Electric Power Distribution for Industrial Plants (booklet). AIEE Committee on Industrial Power Applications.

[2] Governors and the AIEE-ASME Governor Performance Specification. A. F. Schwendner and Wayne Astley. AIEE Technical Paper No. 49-288.

[3] Turbine Generator Controls, Protections and Accessories. G. W. Cunningham and M. A. Eggenberger. AIEE Technical Paper No. 54-40.

[4] Controls for Operation of Steam Turbine-Generator Units. O. N. Bryant, C. C. Sterrett, and D. M. Sauter. AIEE Technical Paper No. 54-154.


# Loose-Jointed Probe Takes Selective Coal Samples

**Submitted by H. R. Patterson**

A NEW TYPE of coal-sampling probe has eliminated a large part of the hard work involved in sampling stoker coal for various municipal installation at Columbus, Ohio.

The city's Service Department discovered that a jointed grain sampler, developed and patented by Richard Handley of the U. S. Dept. of Agriculture, could be used to sample coal just as well as grain. As indicated in the illustration, the probe is constructed from 12-in. long sections of aluminum tubing that fit together to form a rigid tube when driven into the coal. (It has been found that the sampler can be easily pushed by hand three to four ft deep into coal of size 1¼ by ¼, or 1¼ by 28 mesh.)

When the probe is withdrawn from the coal, the sections separate and the open joints take samples from corresponding layers. Chains connect the individual sections so the unit can be removed as a whole.

This sampler has saved us considerable time and labor in sampling coal delivered to the City of Columbus for various municipal installations.

*Editor's Note:* For more information about this probe, write the Editor or jot Loose-Jointed Probe on the prepaid post card in this issue.

Photo of loose-jointed probe shows the sections separate to take samples

# New Aluminum Plant at Coal Mine

OLIN MATHIESON Chemical Corporation plans to enter the aluminum industry with an initial investment of $120,000,000, and with the world's first fully integrated aluminum plant.

The new operation will mark the first time in the history of the aluminum industry when coal mined directly on the site is used to provide the large power requirements for the reduction of alumina to pig aluminum.

Investment in the new operation includes approximately $90,000,000 for the aluminum plant and $30,000,000 for the power facilities needed for the aluminum plant.

The new facilities will be located in the Ohio River Valley. The alumina plant, the reduction plant and the rolling mill will be on the Ohio River near Clarington, Ohio. The power plant to be engineered and built by American Gas and Electric will be slightly upstream on the West Virginia side at Cresap Bottom and will be connected to the aluminum facilities by a high tension transmission line. The power plant will be built on a new major coal mine which will be constructed, owned and operated by the Pittsburgh Consolidation Coal Company.

The power plant, which will be known as the Kammer Plant, will consist of two units of 225,000 kilowatts each. One unit will be owned by the Ohio Power, a subsidiary of the AG&E; the other by a joint subsidiary of Olin Mathieson Chemical Corp. and Pittsburgh Consolidation Coal. Both power units will be operated by the Ohio Power Company and integrated into the AG&E system. The plant will be designed for development up to 1,350,000 kw capacity.

**WOULD YOU LIKE TEAR SHEETS?**

Readers wanting tear sheets of any article appearing in the issue for their personal file may obtain them by indicating the item desired on one of the post cards appearing in this issue—Editors.

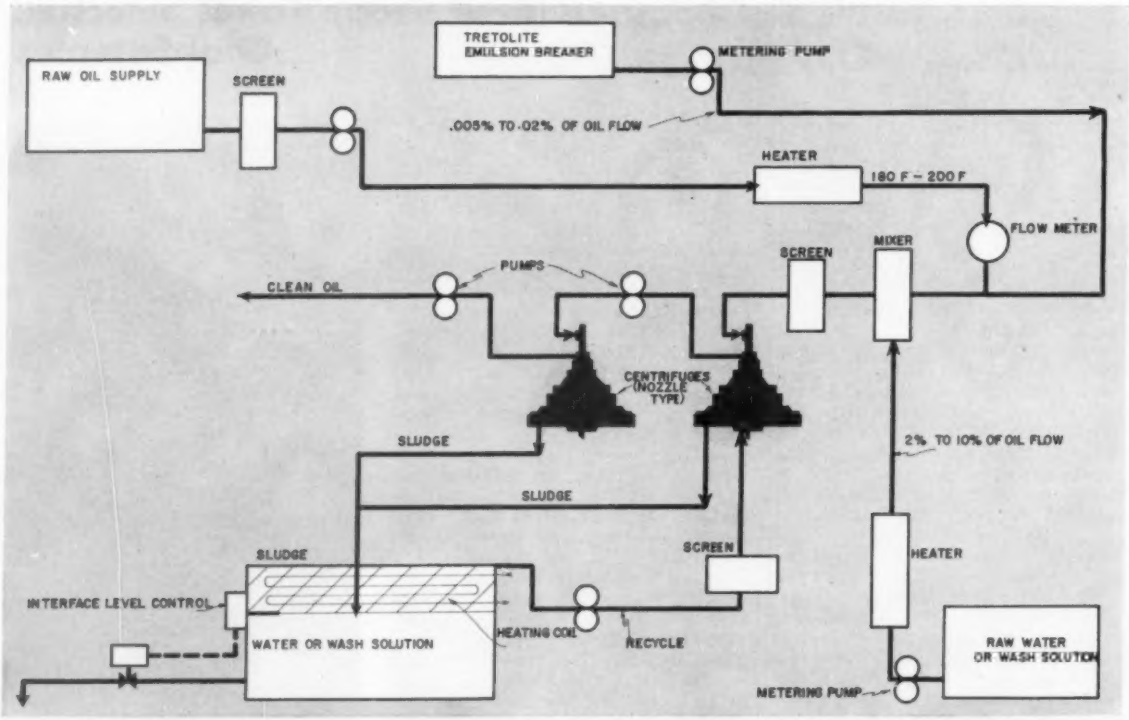



Fig. 1. Schematic diagram of oil-washing system in use at Central Vermont Public Service Corp.'s Rutland Station to remove mineral impurities in gas turbine fuel oils. Oil is dosed, washed, and centrifuged to lower corrosion, deposits

# Economical Fuel Oil Treatment Extends Use of Gas Turbine

**Biggest problem of gas turbine operation is how to burn low-cost fuels without causing deposits, corrosion that lower efficiency, increase maintenance; fuel treatment methods may provide answers**

ONE OF THE CHIEF advantages of the gas turbine is its ability to produce power from low-cost fuels. The drawback in this otherwise ideal situation has usually been that whatever cost reduction is available from use of cheap fuels is offset by corrosion damage to the turbine caused by the impurities normally present in such oil fuels.

Naturally, a great deal of study has gone into attempts to solve this problem satisfactorily. The most obvious solution — removal of impurities from the fuel — has in the past frequently been no solution at all because the cost of cleaning the oil of corrosion-causing contaminents so increased its price that it was no longer a cheap fuel. Nevertheless, this being the most logical approach, much of the work in this field of investigation has been devoted to finding methods of ridding fuel oil of unwanted contaminants without adding significantly to its cost.

Two methods have now been developed which appear to meet these specifications. Both are products of General Electric Co. research — with an assist from other interested manufacturers and agencies. One of these methods has been in use for several years at the power-generating gas turbine installation of Central Vermont Public Service Corp. at Rutland, and results so far are very encouraging. Although the second method has not yet been commercially installed, and actual plant operating data are unavailable, laboratory tests indicate application on a plant-wide scale to be entirely practical and economically feasible.

The impurities in such oils as Bunker C and residuals that cause turbine corrosion and deposits are chiefly sodium, calcium and vanadium. These impurities originate not only in the crude itself, but also in subsequent refinery handling and shipment by sea in tankers. At the Rutland plant, the method developed to remove the metalic contaminants consists of washing and centrifuging. An ASME paper* by Buckland and Sanders of GE describes the process as follows:

The scheme used for sodium removal consists of mixing the oil intimately with water or a water solution of a suitable salt and then centrifuging the mixture. The heart of the washing system is a continuously self-cleaning concentrator type of centrifuge. It discharges clean oil at the top of the bowl while a sludge of wash solution, oil, and suspended solids flows out through a number of small nozzles at the periphery of the bowl. Because the solids are carried out through these nozzles by sufficient liquid, the bowl is essentially self-cleaning and can be run for many hours, if not indefinitely, without shutting down. A diagram of the system in which the centrifuge is used is shown in Fig. 1.

Raw oil is heated, mixed with an emulsion breaker to improve separation in the sludge tank and centri-

* *Modified Residual Fuel for Gas Turbines*, by B. O. Buckland and D. G. Sanders, ASME Paper No. 54-A-246.

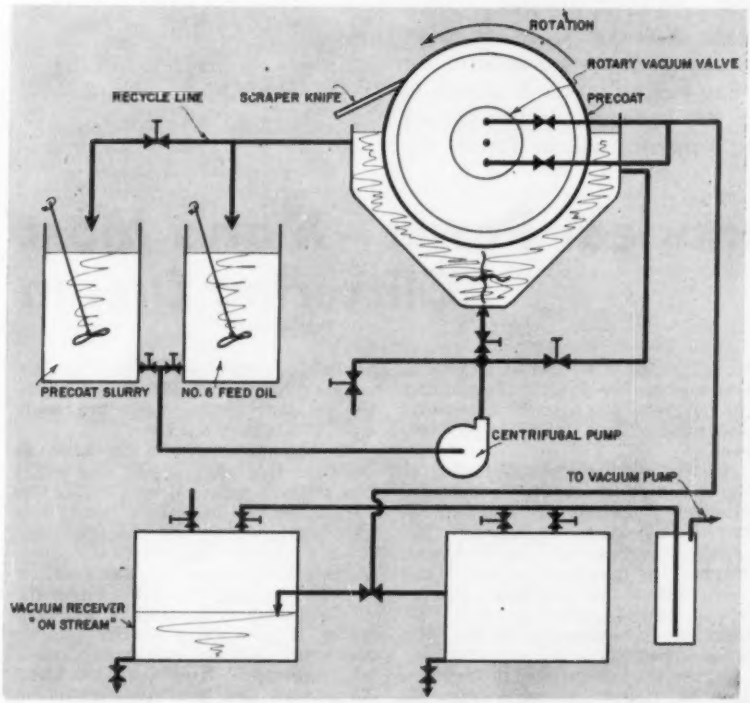



Fig. 2. Schematic diagram of model continuous rotary vacuum precoat filter system used to test filtration of No. 6 oil

fuge, mixed with wash solution, passed through the centrifuges in series, and stored in a clean oil tank. Sludge from both machines goes to a settling tank from which the upper layer is continuously pumped back to the recycle inlet at the bottom of the first centrifuge. In this way, the oil-rich part of the sludge is recirculated until all the oil is finally separated from the water and solids and discharged with the clean oil. The solids collect in the bottom of the settling tank and the water is drained away. In the process the wash solution picks up most of the sodium in the oil, and with a suitable wash solution, such as magnesium sulphate, a substantial fraction of the calcium can be removed also.

It is necessary to have a density difference in order of 2 to 6 per cent between the oil and the wash solution at the centrifuging temperature, depending on the viscosity of the oil and the degree of sodium reduction required. Since some Bunker C oils are about as dense as water, the requirement in such cases is fulfilled by using a wash solution of some salt to provide the necessary density difference, and magnesium sulphate has been found to be very satisfactory for this purpose.

Tests have shown that for a fairly representative group of residuals a reduction in sodium content of 10 to 1 or more can be obtained when the system is operated to give a relatively low water content in the washed oil. [*End of quotation*]

Cost of treating the oil in the manner described was reported as approximately 14 cents a barrel and observation indicates corrosion and deposit conditions to be good.

A more recent development than the method in use at Rutland is a filtration system described by Shields in a recent ASME paper.† This system, so far as is known, has not yet been put into operation commercially, but extrapolation of the laboratory results predicts plant-scale application to be practicable.

The filter used to evaluate the process was a continuous rotary vacuum filter with a drum 2-in. wide by 12-in. in diameter. The filter precoat consisted of a 1½-in. layer of diatomaceous earth deposited on the drum surface by first vacuum-filtering a 2-per cent slurry of earth in oil. When the cake had been deposited to a depth of 1½ in., the slurry was drained from the filter and filtering of fuel oil samples begun. The filter and accessories are shown in Fig. 2.

The essence of this filtering process is the continuous shaving of the filter coat by the scraper knife as the drum rotates, thus removing the outer skin of earth that becomes clogged by the filterable solid impurities in the oil.

† *The Filtration of No. 6 Fuel Oil to Remove Undesirable Trace Metals*, by C. H. Shields, Jr., ASME Paper No. 55-A-121.

In a series of tests using diatomaceous earth as precoat material, continuous rotary vacuum filtration reduced sodium content of the test No. 6 fuel oil to an average concentration of 3 ppm from original concentrations of 75 to 217 ppm. Specific values after treatment covered the range from 1 to 10 ppm.

In the same tests, calcium content was reduced to an average concentration of 39 ppm from original concentrations of 100 to 250 ppm. Results of combined analyses of a typical No. 6 fuel oil before and after filtration are shown in the accompanying table.

### Test Results

The results of the test reported indicate that the filtration process can remove most sodium and lead, some calcium, and certain other trace elements from the batch of No. 6 oil used in the tests. Similar results were also obtained in tests using other No. 6 fuel oils, but these are applicable in general only to the extent that the oils tested were representative of all fuel oils.

With regard to the persistence of vanadium in the filtered oil, it is believed that the element exists as an organic complex in the oil. Some of the calcium also appears to be elusive for presently unknown reasons. Experiments are continuing along these lines; reaction with chemical additives followed by filtration may be productive. Some success has been achieved in the reduction of calcium but vanadium content has been only slightly reduced.

To illustrate the practical possibilities of the filtration process, some figures were extrapolated from the experimental results. These figures predict an operating cycle of up to 249 hr per in. of shaveable precoat, during which time as much as 533 gal. of treated oil would be passed by each square foot of filter area. Cost, depending on rate of filtration, varies from about 1½ cents per gal. at 2.14 gph flow rate per sq ft area to about 17 cents per gal. at 5.5 gph per sq ft area.

Table shows results of analyses of a No. 6 fuel oil before, after filtration

| | Before Filtration | After Filtration |
|---|---|---|
| Na | 217 ppm | 2 ppm |
| Ca | 250 | 48 |
| Ni | 20 | 14 |
| Al | 23 | 4.1 |
| Fe | 47 | 20.5 |
| Pb | 13.6 | 2 |
| Cr | 2.1 | 2 |
| Mg | 18 | 5.8 |
| V | 38 | 31.8 |
| Cu | 8 | 2 |
| Zn | 16 | 16 |
| Ag | 1 | 1 |
| Mn | 2 | 2 |
| Ti | 2 | 2 |
| Sn | 2 | 2 |
| Total ash | 1200 | 260 |
| Sediment, per cent | 0.0860 | 0.0097 |

No prospect for man's future development holds greater promise than the possibility of achieving a controlled thermonuclear reaction. Beside it, the harnessing of solar energy or the world-wide use of atomic energy from fission fade into insignificance. If success in this direction is ultimately achieved, the hydrogen in the oceans could furnish man with an everlasting supply of energy for his use

# Thermonuclear Power—Man's Most Glittering Dream

**By ANDREW W. KRAMER**
Editor, POWER ENGINEERING

FEW ASPECTS of nuclear science have been of more intriguing interest the last two years than the possibility of developing a controlled thermonuclear reaction. Officially, virtually nothing has been released concerning details of thermonuclear research anywhere but ever since the explosion of the first hydrogen bomb, or thermonuclear *device* as the gadget is officially called, there have been vague rumors on the use of the hydrogen *fusion* reaction for power purposes. At first these rumors were never confirmed by any spokesman of the AEC or the United States government but last summer at the Atoms-for-Peace Conference at Geneva, Switzerland, the question was brought into the open by Dr. Bhabha of India. As Chairman of the Conference, in his opening address, he referred to the theoretical work that had been done in India on the problem of developing a controlled thermonuclear reaction and indicated that there was good reason to believe that such a reaction might be attained.

This immediately led Britain to assert that British scientists had been working on the problem, and Sir Edwin Plowden at a press conference on August 10 spoke of fusion power within a "generation". Then, the next day — August 11 — our own Atomic Energy Commission, before a packed gallery, finally let itself be smoked out just a little on the Fusion-for-Peace question. In response to numerous questions, AEC Chairman Lewis Strauss admitted that the United States had a Fusion-for-Peace program of moderate size under way. Later, Mr. Strauss denied that the subject had been dragged out in the open as a consequence of Dr. Bhabha's address, and stated that at a Commission meeting sometime prior to the Geneva Conference, it had been decided that the Geneva meeting would offer a good forum for announcing the AEC's interest in it.

Later, at a conference on this side of the Atlantic, the AEC announced that controlled thermonuclear research was being carried on under Project Sherwood at three different places — at Los Alamos and Livermore Laboratories, and at Princeton University. No inkling concerning the nature of the research carried on under this project was disclosed, however.

In view of this reticence to discuss the subject, it is of considerable interest, therefore, to find in the recently released "McKinney" Report on the Peaceful Uses of Atomic Energy, the first more or less official discussion of the problems involved in this field of nuclear research. This discussion was prepared by the Sherwood division.

True, this discussion in the McKinney Report presents virtually nothing that was not known before; nevertheless it seems to imply that the chances of success are perhaps somewhat better than has been supposed. Heretofore, nearly everything that has been said and written about a controlled thermonuclear reaction has stressed the almost insuperable difficulties that lie in the way of success in this field. Even the most optimistic estimates have not placed the attainment of a controlled fusion process any closer than 25 years.

It is of interest, therefore, to read in the McKinney Report: "It is virtually certain that no full-scale (thermonuclear) reactor will be developed in the next *year or two;* it is, however, *highly probable* that success will be achieved eventually."

### Is Idea Fantastic?

Assuming that the report was written with some care, why would the writers say that success is *highly probable* if the idea is as fantastic as has been supposed? And why would they have used the time period, *year or two*, rather than decade or two, which would have been entirely justifiable? It is possible that this is of less importance than we attribute to it but in view of the language of the report, it is difficult not to feel that more has been learned about thermonuclear processes than is reflected in the brief discussion by the McKinney panel.

Until the first hydrogen bomb was exploded in the Pacific there had been little interest in thermonuclear reactions. Practically all effort in the development of nuclear energy for power was concentrated on the fission reaction, using uranium-235 as the fissionable material. The atomic bombs dropped on Japan and all of the nuclear reactors to date are based upon this type of reaction.

In the meantime, in the interval between the early 1940's and 1951, our scientists learned how to use the *fusion* reaction in making the hydrogen bomb, and so did the Russians. This evidently was relatively easy; indeed, this type of nuclear reaction was known long before the discovery of the fission of uranium in January 1939. It goes back to the famous Cockcroft-Walton experiment made at Cambridge University in 1932. This was the first experiment in which transmutation of the elements was achieved by the use of particles that were accelerated artificially. Previous to that time, Rutherford had shown, as early as 1919, that nitrogen could be transmuted into oxygen but he used the high energy alpha particles from radium to effect this transmutation. Cockcroft and Walton bombarded lithium with hydrogen nuclei (protons) accelerated by high electric potentials.

The apparatus which Cockcroft and Walton used is shown in Fig. 1. It consists of a proton gun, comprising a heated cathode shown at C and accelerating electrodes A and B. Thermionic electrons emitted by the cathode are accelerated by the positive potential applied to anode A. Passing through the aperature in A into the space beyond, which is filled with hydrogen gas at low pressure, the electrons ionize some of the hydrogen atoms. The ions being positively charged are accelerated by the cathodes B-B, these being at a potential of 150,000 v with respect to A. The fast moving protons, however, pass through the apertures in the two cathodes and form a proton beam which impinges on a lithium target at the end of the tube. Here the high-energy protons react with the lithium atoms to produce helium nuclei (Alpha particles) in accordance with the following reaction:

$$_1H^1 + {}_3Li^7 \rightarrow {}_2He^4 + {}_2He^4 + 17.1 \text{ MEV}$$

This equation expresses the ultimate effect.

Actually what happens is shown in Fig. 2, which shows a proton being added to a lithium nucleus. The latter, it will be noted, consists of 3

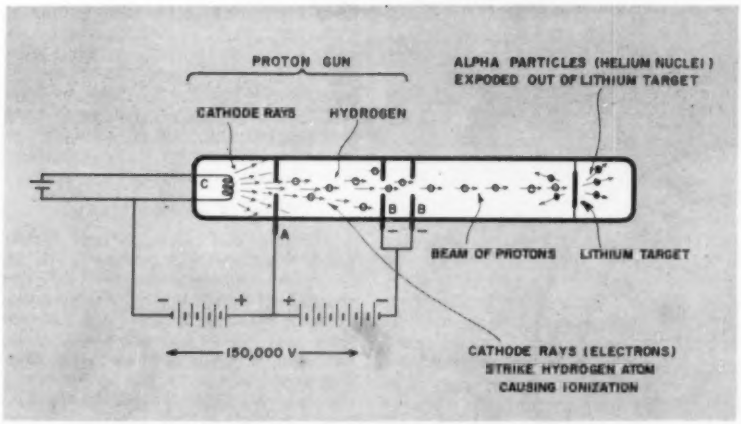



Fig. 1. Here is a diagram of equipment used in the Cockcroft-Walton Experiment

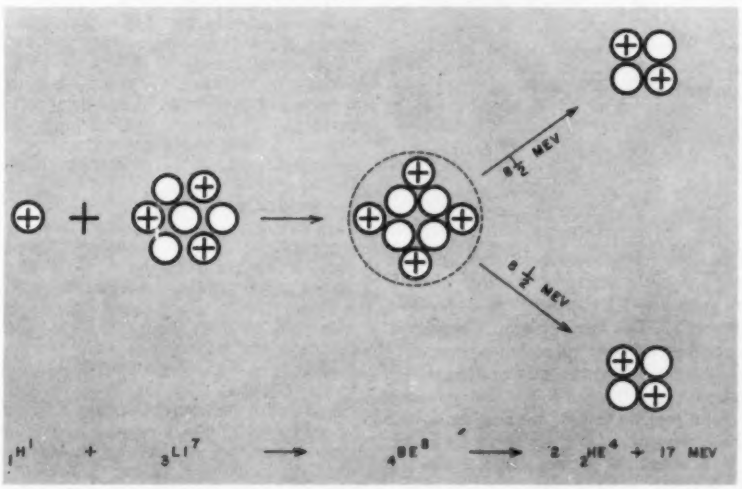



Fig. 2. This shows what actually happened in the Cockcroft-Walton experiment

protons and 4 neutrons giving the nucleus as a whole an atomic weight of 7. The 3 protons, of course, have positive charges and normally would repel any other positively charged particle that tried to approach it. The oncoming proton, however, is traveling at such a high velocity that it succeeds in piercing the powerful barrier of electric force that surrounds the nucleus, and thus, for an appreciable moment, becomes a part of the new nucleus. This new nucleus is a beryllium nucleus since it has atomic number 4. This isotope of beryllium, however, cannot exist; it is not found in nature. Thus, when it is formed artificially in this manner it is extremely unstable and in, say, a tenth or a hundred millionth of a second, it explodes violently into two equal halves — two helium nuclei. The explosion is one of extreme violence because the loss of mass involved in the reaction is converted into energy in accordance with Einstein's law of mass-energy equivalence. The amount of energy released is 17.1 million electron volts.

This experiment works nicely in the laboratory but physicists were quick to point out that while it was true that for every proton that entered a lithium nucleus a hundred times as much energy was released as was used in firing the proton, only a few of the millions of protons fired made direct hits. Viewing the process as a whole, much more energy was expended in accelerating the protons than was released in the reaction.

At the time these facts were first realized these limitations were sufficient to discount the value of the Cockcroft-Walton experiment from a practical standpoint and it was almost forgotten in the years between 1935 and 1945. Today, however, after the development of the atomic and hydrogen bombs, the Cockcroft-Walton experiment may once again loom of great significance in the affairs of man. What is needed is a method whereby a much greater proportion of protons are brought into direct collision with lithium nuclei.

To anybody with a basic knowledge of thermodynamics, an obvious way of doing this would be to raise a mixture of hydrogen and helium to a high temperature. When the temperature of a body is raised, more kinetic energy is imparted to the atoms and molecules and they move at greater speeds. As a consequence they suffer more violent collisions. Thus, as the temperature of a mixture of lithium and hydrogen was raised, the speeds and kinetic energies of the nuclei would increase, and if the velocities were sufficiently high, *fusion* would take place. Once such fusion was started in an appreciable portion of the mixture, the enormous energy release would carry the reaction to all parts of the mixture.

This, in effect, is what happens when we kindle a fire. We raise the temperature of a local portion of the fuel by applying the flame of a match and the kinetic energy of the molecules in the incandescent gas is, thus, imparted to the molecules of the cool fuel. This increased kinetic energy causes the carbon atoms in the fuel to combine with the oxygen atoms in the air. The resulting reaction is what we call the process of combustion. The energy so released is imparted to adjacent parts of the fuel and so a chain reaction is established. If we could do the same with hydrogen and lithium nuclei, we could bring about the thermonuclear reaction we desire.

### How Get Temperatures?

In the process of combustion, however, only the external electrons of the atoms are involved — not the nuclei. To bring the nuclei of the atoms together requires much greater energies and, therefore, very much higher temperatures. Indeed, when we calculate the energies we find that we need temperatures of many million degrees!

Now, at the present time the only way we can attain such temperatures on earth is by means of the fission reaction in the uranium type of atomic bomb. Hence it was deduced that the explosion of a uranium-235 bomb could, if properly applied, heat a lithium-hydrogen mixture to the temperature necessary to start a fusion chain reaction. The exact nature of the reactions in the hydrogen bombs that have been exploded has never been disclosed but the fact that such bombs have been exploded is evidence that some type of fusion reaction has been made to work.

This dependence upon these extremely high temperatures makes the control of a fusion reaction almost inconceivably difficult. As pointed out in the McKinney Report, it is clear that no container of ordinary material can confine such temperatures without vaporizing instantly. The only media which conceivably are capable of fulfilling this task are electric and magnetic fields, the appropriate use of which might serve to insulate the walls of the reaction chamber from the excessively high temperature at the center.

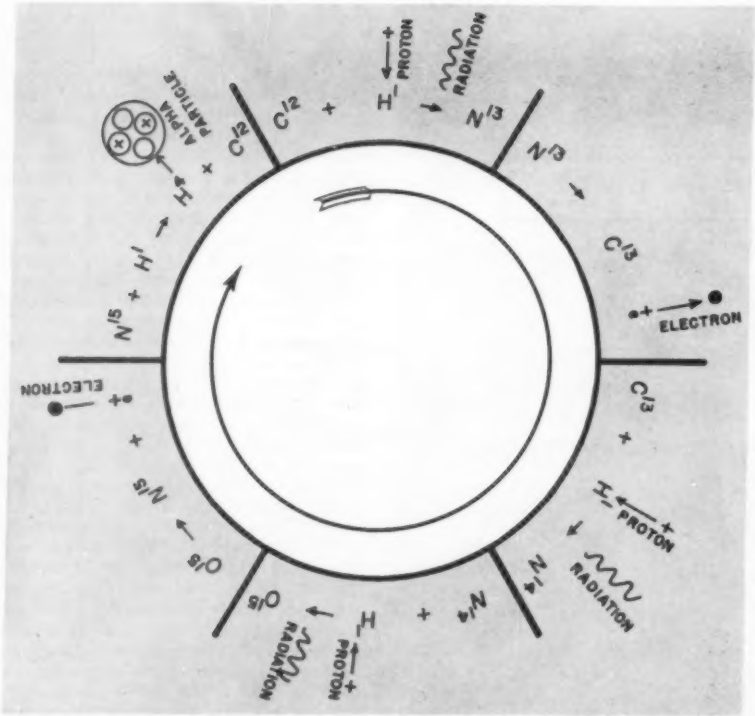



Fig. 3. The carbon-nitrogen cycle. . . . This shows how helium is built up from hydrogen nuclei in the sun and other stars. The cycle starts at the top when a carbon nucleus fuses with a proton to form nitrogen-13. By emiting a positive electron the nitrogen-13 transmutes into carbon-13. This again absorbs a proton, becoming nitrogen-14. The latter absorbs another proton, becoming oxygen-15. When this oxygen isotope emits a positive electron it changes to nitrogen-15. When nitrogen-15 absorbs a proton it becomes oxygen-16 but this is unstable and immediately emits an alpha particle, i.e., the helium atom nucleus, and thus reverts to the original carbon-12. The carbon and nitrogen thus serve as a sort of matrix to lock four protons together to form a helium nucleus which is emitted

Thus, in essence, the problem involved is that of ionizing a suitable material (such as deuterium) [1] heating the resulting *plasma* [2] to temperatures of 10,000,000 degrees or higher, and confining it at such temperatures for a sufficiently long period of time to permit an appreciable fraction of the ions to fuse, with consequent release of energy. To be of general usefulness, the heat energy thus released must be converted into electrical power, either directly or through the medium of suitable heat exchangers.

### Stellar Thermonuclear Reactions

It had been suspected for many years that the continued radiation of energy from the sun and stars had its origin in some sort of thermonuclear reaction. Close study of the problem, however, indicated that the lithium-hydrogen reaction was not the one responsible for the sun's heat because that reaction at the central solar temperature would be too fast. All the lithium and hydrogen in the sun would be transformed into helium in a few seconds, and the energy liberation would take the form of a tremendous explosion.

The problem was solved simultaneously and independently by Dr. Hans Bethe in this country and Dr. Carl von Weizacker in Germany, in 1938. It proved to be a hydrogen-helium reaction but it was not limited to a single nuclear transformation. The thermonuclear process of the sun consists of a whole sequence of linked transformations forming a reaction chain. One of the interesting features of the sequence reaction is that it is a closed cycle, returning to the starting point every 6 steps. Another interesting fact in the process is that the nuclei of carbon and nitrogen which enter into an alchemic reaction with the hydrogen do not vanish, but are regenerated again through a very peculiar process known as the carbon-nitrogen cycle. The carbon and nitrogen act as a sort of catalyst to effect the transformation of four protons into a helium nucleus.

Still more astonishing about this process is its extremely low specific heat release, which under the conditions prevailing in the sun is only 2 ergs, per gram, per second. This is only a tiny fraction of the heat produced by an ordinary candle flame! An obvious question, then, is how can such an inefficient source of heat account for the vast energy release from the sun and for its temperature of millions of degrees?

### Why So Much Energy?

The answer to this question lies in the tremendous size and mass of the sun. The temperature level at the center is determined by the equilibrium between income and the release of heat by radiation. The radiation is proportional to the surface area and the fourth power of the absolute surface temperature. The heat production, however, is proportional to the volume, and since the ratio between the volume and the surface of a sphere is one third of its radius, it should be obvious that the equilibrium temperature reached in an internally heated sphere will depend on its absolute size. Thus, a slow working process like the carbon-hydrogen cycle can heat a ball the size of the sun to a temperature high enough to sustain the process because 33,000 *tons* of matter, of which a high percentage produces energy, lie behind each square *centimeter* of radiating surface. The same process, however, is far too feeble to work in any object of terrestrial dimensions.

From these theoretical studies it was quite evident from the beginning that the thermonuclear processes in the stars could be of no practical use to us. Actually the carbon-hydrogen reaction in the sun takes six million years to complete one cycle.

Fortunately, or perhaps unfortunately, however, there are many other fusion reactions producing energy at a far more rapid rate and some of these have obviously been used in the design of our (and also the Russians') hydrogen bombs. Although it has never been officially confirmed, it is generally believed that the first hydrogen bomb we exploded, in 1951, was a tritium-deuterium bomb. That is, the reaction was: $D + H^3 \rightarrow He^4 + n + 17$ MEV. Subsequent improvements in both Russia and U. S. seem to have been made in using fusion reactions between lithium and deuterium. Again, this is largely conjecture, and the process in the real H-bomb might be quite different from those referred to here.

### Controlled Reactions

Using a thermonuclear reaction in the design of a bomb is relatively easy compared to the problem of controlling such reactions so that they can be used to develop power. Even if we could hold the fusion material at the millions of degrees necessary, the reactions would be too fast to be of any use, unless we could make them small enough so that a series of many small explosions like those in an internal combustion en-

[1] Deuterium is the heavy isotope of hydrogen.
[2] A plasma is a concentration of ionized gas.

gine could be used to drive a mechanical system.

While some of the possible thermonuclear reactions utilize slow neutrons, and therefore might proceed at medium temperatures, they differ from the fission reactions in that they do not produce any more neutrons to continue the reaction. To continue such reactions some other neutron-producing reaction must be added to complete the cycle. All such reactions, however, can be kept going only at temperatures of millions of degrees and this, as already pointed out, rules out any material type of container. Nor could control rods such as are used in fission reactors be used to control processes involving temperatures of millions of degrees. Equally impossible would be any stabilizing effect such as the negative temperature coefficient inherent in certain types of fission reactors.

Size also is an all-important influence in thermonuclear processes. As already explained, the carbon-helium cycle is possible in the sun because of the sun's great size and mass. Dr. Louis Ridenour has made up an interesting chart showing the specific power output of deuterium-deuterium and tritium-deuterium fusion reactions as a function of temperature. This chart is shown in Fig. 4. The broken curves show the power required by internally heated bodies to attain the given temperatures. Curves for four different sized bodies are drawn, one for particles the size of a grain of dust, one for a mass the size of a basketball, a third for a body the size of a mountain, and finally, one for a body the size of a star. It will be noted that the temperature required increases as the size of the body decreases. As an example, the chart shows that a thermonuclear reaction might be possible in a body the size of a bomb (football) in a t-d (tritium-deuterium) mixture but not in pure deuterium (d-d). On the other hand, in the case of a body the size of the sun (star) it is evident that either type of fusion material would result in a thermonuclear reaction even at relatively low temperatures.

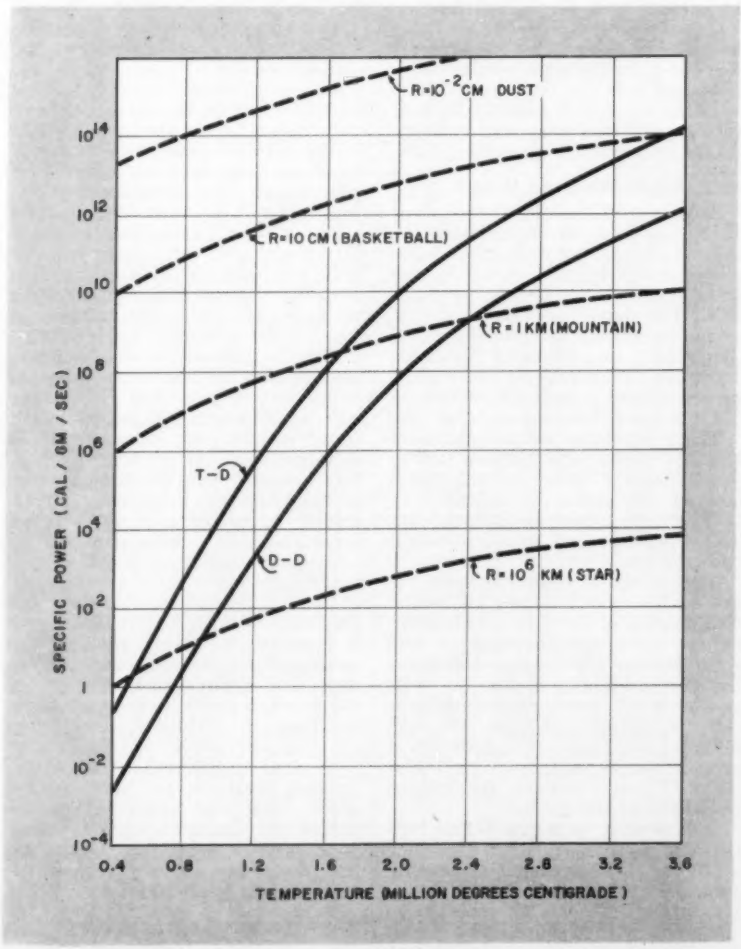



Fig. 4. Chart showing specific power output of d-d and t-d fusion reactions as a function of temperature for four different size bodies, as explained in the text

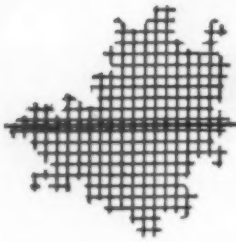
From these facts it seems doubtful whether a fusion reaction using deuterium or tritium could ever be found that produces heat quickly enough to heat a particle the size of a grain of dust, and yet, this is exactly what would be desirable in a controlled thermonuclear reaction. Anybody who has ever looked at the fuel nozzle of a large diesel engine is impressed with the minuteness of the passages through which the fuel enters the cylinder. They are very small needle-like holes. Yet the tiny streams of fuel oil entering the high temperature in the cylinder are capable of developing enormous power. If, in some way, it were possible to develop an extremely high localized temperature — something on the order of tens of millions of degrees — a minute quantity of the proper type of fusion mixture fed into that region of high temperature would undergo fusion, and release a vast amount of heat energy.

As mentioned previously, a great many fusion reactions are possible and there is little doubt that many of them are under investigation. Before the problem is finally solved — assuming that it will be solved — much more will have to be known about the way in which the protons and neutrons in the nucleus of the atom are put together. Even the simplest nuclear reactions are complex.

### Complex Reactions

For example, in the relatively simple nucleus of ordinary carbon, containing 6 protons and 6 neutrons, 32 different energy levels of internal energy have been identified. In the nucleus of the uranium atom, containing 92 protons and 143 neutrons, it might be thought hopeless to try to understand the complex modes of internal motion and the countless energy levels. It is, however, becoming clear that protons and neutrons are not thrown into a nucleus at random like apples in a basket. Nuclear particles seem to fall into subgroups or shells in which their motions have simple regularity, and from the work already done in university laboratories there appears definite hope that we may be able to understand the law of force between neutrons and protons well enough to calculate their interactions and modes of motion and arrive at energy levels which agree with observation.

It is to this end largely that the great accelerators are being used in our university laboratories. By bombarding various nuclei with high energy particles many strange new particles emerge after the impact, many of which have only a transitory existence. The fundamental significance of these transitory particles has aroused the interest of scientists all over the world. When the mystery of their nature, their formation, and their function is finally unraveled, there is little doubt that we will be much closer *continued on page 108*



# Graphical Boiler Heat Balance

**Heat balance chart last month gave losses due to incomplete combustion; in Sept. 55 dry flue gas losses; in Aug. 55 losses due to hydrogen in fuel and in April 55 losses due to moisture in the fuel**

## Heat Losses Due to Radiation . . . . . BY PAUL J. GROGAN *

THE LOSS OF HEAT due to radiation from the boiler and setting is an item which cannot be calculated easily. In the past, the radiation loss was considered along with other unaccountable items totaling some six to 10 per cent of the heat energy in the fuel. Present good practice requires that all boiler losses not exceed eight to 16 per cent.

The unaccountable losses are correspondingly lower. The margin of uncertainty and error is vanishing. Better methods of predicting boiler heat balance losses — and thereby efficiency — are required.

### Industry Standard Available

The American Boiler and Affiliated Industries Standards Committee has prepared and released a *recommended standard* for estimating the radiation loss. Their recommendation is available in graphical form and appears here with their permission.

Means are now at hand for estimating the amount of radiation loss with sufficient accuracy to warrant listing such an item in a boiler heat balance. Further, the recommended standard for unaccountable losses is now 1.5 per cent.

The latest ABMA recommended standard is based upon boiler or steam generator output in millions of Btu per hour. The range of output is from one million to 4,000 million Btu per hour. The approximate equivalent range of output in pounds of steam per hour is 1,000 to 4 million.

The chart, therefore, has application from very small units to the extreme large units contemplated for the future. The conversion between million Btu per hour and thousand pounds of steam per hour should not be used for large, high-pressure units with a high degree of superheat and one or two reheat stages. The two measures of heat energy may differ by as much as 25 to 45 per cent in such instances.

The actual heat loss due to radiation is practically constant for a given boiler. Radiation is largely a function of the furnace wall construction and the wall area.

Smaller units have a larger amount of furnace wall per unit of output. Also, their wall construction may lead to an even higher loss due to radiation. Smaller units commonly depend upon a greater portion of exposed refractory for maintaining more nearly ideal combustion conditions.

The relation between furnace wall surface, including ceiling and floor, and volume is demonstrated in the following table based upon the laws of similitude:

**Influence of Furnace Dimensions upon Ratio of Wall Area to Volume**

| Unit | Width | Depth | Height | Area- ft² | Volume- ft³ | Area/ Volume |
|---|---|---|---|---|---|---|
| A | 15′ | 20′ | 30′ | 2,700 | 9,000 | 0.300 |
| B | 30′ | 40′ | 60′ | 10,800 | 72,000 | 0.150 |
| C | 60′ | 80′ | 120′ | 43,200 | 576,000 | 0.075 |

The above three furnaces are of the same general proportions, but vary in size. The smaller unit has twice the exposed area per unit of furnace volume when compared with the middle unit and four times the exposed area per unit of furnace volume when compared with the large unit. These ratios are a crude measure of the loss due to radiation versus the design output of the steam generating unit.

### Applications of Graph

Referring to the chart, the curve 'Radiation Loss at Maximum Continuous Output' appears to be more or less inversely proportional to the output rating of the steam generating unit. The curve is relatively flat along the middle third of the capacity range, but shows a favorable downturn in the range of very large capacities and a pronounced upturn in the range of the smaller capacities.

The reduction in per cent radiation loss in extreme large units is due to the favorable area volume ratio pointed out above. It follows, too, that such large units employ the very best type of tangent tube water wall construction.

The upturn in radiation losses for the smaller units is largely due to the combination of the unfavorable area/volume ratio and the type of wall construction. The contour traced by the curve actually applies to units operating at their maximum continuous output and does not take into account the correction for operation below capacity, or for water walls. Those variables are treated elsewhere on the chart.

The penalty in terms of per cent loss due to radiation when operating a large unit below its maximum continuous output may be seen by tracing through the dotted example on the graph. A 150 million Btu per hour unit operating at its maximum continuous capacity has a 0.83 per cent loss without influence of water walls. The presence of three water walls per the dotted example reduces that loss to 0.67 per cent.

The same unit operated at 75 million Btu output per hour has a 1.66 per cent loss without water walls and 1.34 per cent loss with three water walls. It is interesting to observe that the per cent loss is precisely doubled when the unit is operated at 50 per cent maximum continuous output.

Other conditions imposed by the recommended standard are that the furnace wall must have at least one third of its projected surface water cooled before the reduction in radiation loss is permitted. Also, the correction for air cooled walls is permissible only if the cooling air is used for combustion.

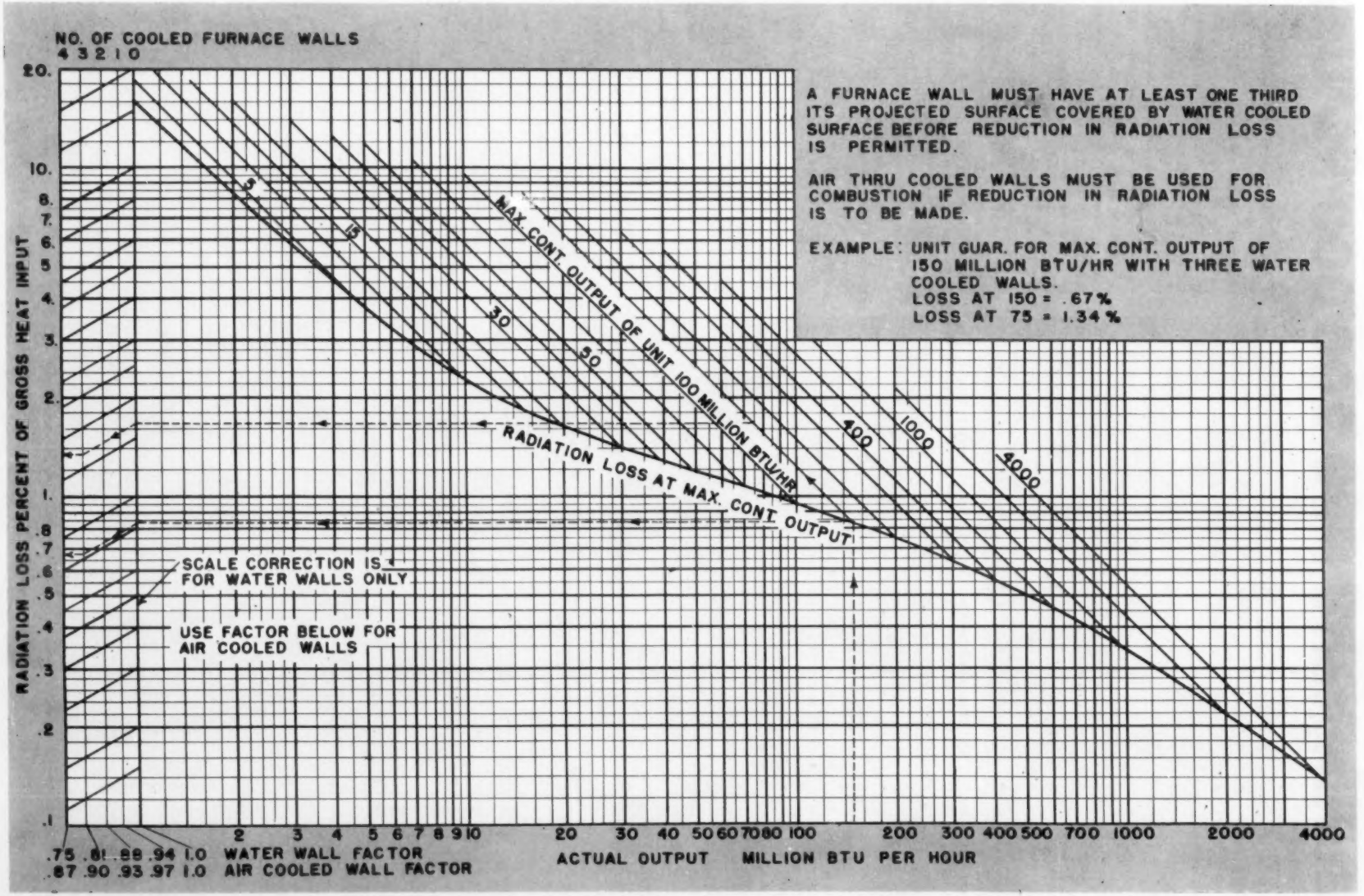
Air cooled conditions may not be read directly from the curve, but have to be derived from the factors given at the extreme lower left corner of the chart. Each water wall is credited with reducing the radiation loss approximately 6 per cent. If we assume a unit with a maximum continuous output rating of 150 million Btu per hour, but operated at 75 million Btu per hour, the potential radiation loss is 1.66 per cent before the influence of cooled walls is taken into account.

For the purposes of this example, assume there are two water walls and an air cooled front wall. The water wall factor is 0.88 and the air cooled factor is 0.97. The radiation loss is approximately $(1.66)(0.88)(0.97) = 1.42$ per cent. The above figure can be approximated graphically by assuming 2.5 water walls rather than using two water walls plus one air cooled wall with approximately one half the cooling effect of a water wall.

Good building construction and placement of forced draft fans makes it possible to recover much of the radiated heat. Studies have shown that this conservation of heat by the building structure is a good argument against outdoor or semi-outdoor construction in most climates.

The calculated radiation loss still applies, however, for heat balance work. The heat recovered at the forced draft fan inlet is taken into account when determining the dry gas loss and other items involving the temperature of air supplied.

* Chairman, Department of Engineering, and Director of Engineering Institutes, University Extension Division, University of Wisconsin. All re-publication rights reserved by author.


NO. OF COOLED FURNACE WALLS
4 3 2 1 0
A FURNACE WALL MUST HAVE AT LEAST ONE THIRD ITS PROJECTED SURFACE COVERED BY WATER COOLED SURFACE BEFORE REDUCTION IN RADIATION LOSS IS PERMITTED.
AIR THRU COOLED WALLS MUST BE USED FOR COMBUSTION IF REDUCTION IN RADIATION LOSS IS TO BE MADE.
EXAMPLE: UNIT GUAR. FOR MAX. CONT. OUTPUT OF 150 MILLION BTU/HR WITH THREE WATER COOLED WALLS.
LOSS AT 150 = .67%
LOSS AT 75 = 1.34%
RADIATION LOSS PERCENT OF GROSS HEAT INPUT
20.
10.
8.
7.
6.
5.
4.
3.
2.
1.
.8
.7
.6
.5
.4
.3
.2
.1
5
15
30
50
MAX. CONT. OUTPUT OF UNIT 100 MILLION BTU/HR
100
1000
4000
RADIATION LOSS AT MAX. CONT. OUTPUT
SCALE CORRECTION IS FOR WATER WALLS ONLY
USE FACTOR BELOW FOR AIR COOLED WALLS
2 3 4 5 6 7 8 9 10 20 30 40 50 60 70 80 100 200 300 400 500 700 1000 2000 4000
.75 .81 .88 .94 1.0 WATER WALL FACTOR
.87 .90 .93 .97 1.0 AIR COOLED WALL FACTOR
ACTUAL OUTPUT MILLION BTU PER HOUR

# Burlington's New 200,000 kw Unit

**Careful attention to details yields high efficiency unit at Burlington Generating Station, Public Service Electric & Gas Company, to meet growing load demands. Outdoor pressurized boiler, unusual coal handling system, completely centralized control, flue gas recirculation, tandem-compound turbine generator, 8 extraction points, rotary vacuum pumps are some of the features**

PUBLIC SERVICE Electric & Gas Co.'s system in New Jersey has had tremendous load growth since 1945. To meet the demands, new units have been installed in the Essex Generating Station; a complete new station was built at Sewaren; two new units were put in service at Kearny, and even before the latter machines were in service, plans were started for new capacity at Burlington.

To take care of growth in the immediate future, new generating stations are also being built at Linden and Bergen. On completion of the latter, the total effective generating capacity of the company's seven stations will approximate 3,000,000 kw.

The new 200,000-kw Burlington Unit No. 7 consists of a Westinghouse turbine generator and one B&W boiler arranged in the unit system. The control room for this unit is located at turbine floor level, adjacent to turbine and boiler. The new unit is operated with practically no ties, electrically or mechanically, with the old station. Pulverizers are B&W; American Blower F D fans, driven through hydraulic couplings, supply air for pressurized furnace operation; Sturtevant Div. of Westinghouse I D fans are installed for suction operation and an American Blower fan recirculates flue gas.

The feedwater heating cycle, Fig. 1, includes 8 stages of heating with 6 heaters and 4 drain coolers (with Swartwout heater drain controls) on the suction side of the boiler feed pumps. All heaters are Foster-Wheeler, with shells welded to eliminate flanges.

Three Worthington boiler feed pumps and three Worthington condensate pumps are installed for the unit. They are motor-driven through American Blower hydraulic couplings. The condensate and boiler feed pumps are paired electrically to operate through the same breaker from the same starting switch so that the condensate pump and its associated boiler feed pump start and stop together.

This is designed to prevent damage to the feed pump from low suction pressure. Make-up for the unit is obtained by demineralizing city water in a Permutit 50-gpm completely-automatic mixed-bed unit. Main piping systems are by M. W. Kellogg.

Features of the new Burlington boiler, Figs. 4 and 5, include reheat, pressurized firing, flue gas recirculation and tempering, and high steam temperatures and pressures. Capacity is 1,225,000 lb per hr continuous, with 4 hr maximum rating of 1,350,000 lb per hr.

Main steam temperature is 1100 F and reheat temperature is 1050 F. Superheater outlet pressure is 2389 psig. Furnace is of the wet bottom type with continuous slag discharge and is equipped to burn either coal or oil. Boiler efficiency is 91.17 per cent.

There are 20 coal and 20 oil burners located at 4 levels at the front of the boiler. The oil guns may be inserted or retracted by automatic devices controlled from the central control room, Fig. 3. The pressurized furnace is rendered gas tight by a pressure casing tangent to the outside surface of the wall tubes.

The turbine generator operates at 2350 psig, 1100 F at the throttle and 1050 reheat temperature, as shown in Fig. 1. It is a tandem compound, 3600-rpm machine consisting of a high-pressure section, a reheat single-flow intermediate-pressure section

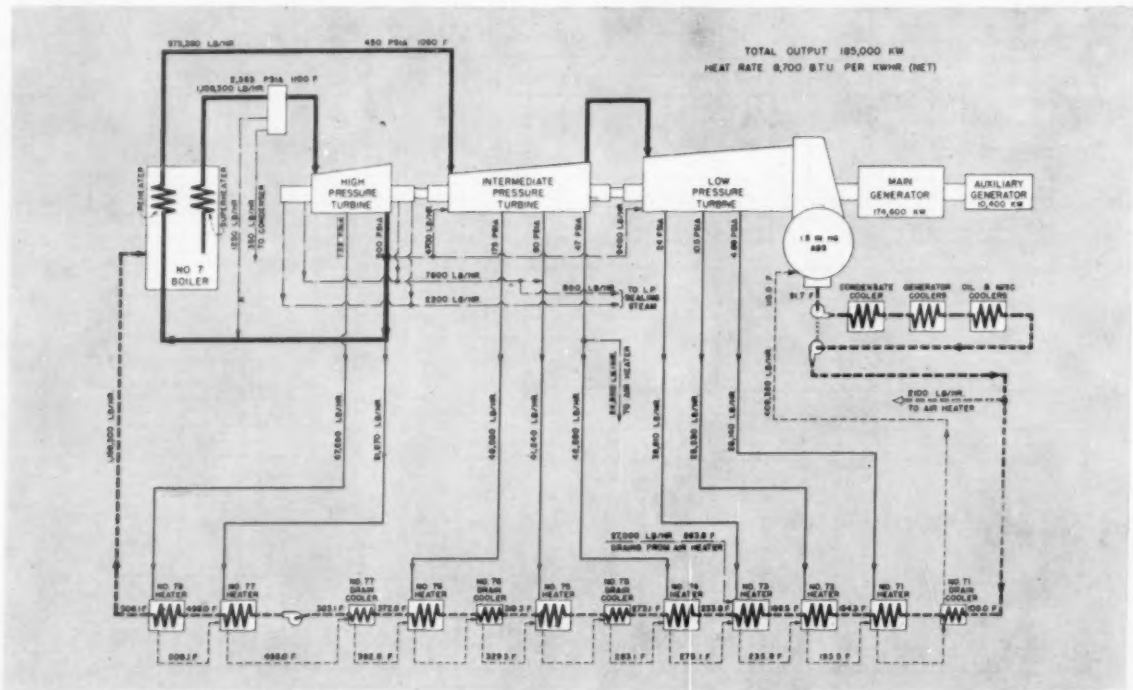



Fig. 1. Heat balance diagram Burlington Unit No. 7 showing total unit output of 185,000 kw at 8,700 Btu per kwh (net)

# No. 7 Averages 9,000 Btu per kwh

and a triple-flow low-pressure section. Certain areas of the turbine exposed to the hot inlet steam use partially expanded steam as a coolant. The turbine drives the main generator and an auxiliary 12,500-kw generator in tandem; main generator voltage is 13,800 and auxiliary generator voltage is 4160. Excitation for the unit is supplied by two separate motor-driven exciter sets.

An automatic fine-fog spray fire-protection system is provided for the lubricating oil reservoir, storage tanks; purification unit and hydrogen detraining system.

The Worthington condenser is of the divided water box type of 80,000 sq ft. A single hot well is provided and deaeration of make-up and drains is accomplished with deaerating trays in the main condenser.

One room, sound proof and air conditioned, is provided for all the controls of the new unit, as shown in Fig. 3. Panel components are miniature and compactly arranged in a curved console. Instruments for record purposes only are located in the wings of the control room. Telemetering is used extensively and television apparatus views combustion conditions in the boiler. Combustion control is Leeds & Northrup. Feedwater control system is Bailey 3-element.

One of the most unusual features of the new unit is the coal handling system which embodies an active outdoor bunker pile. A swing-boom conveyor can place approximately 25,000 tons of coal in a kidney-shaped pile 60 ft. high. Three 12-ft diameter conical hoppers located below grade *continued on page 112*

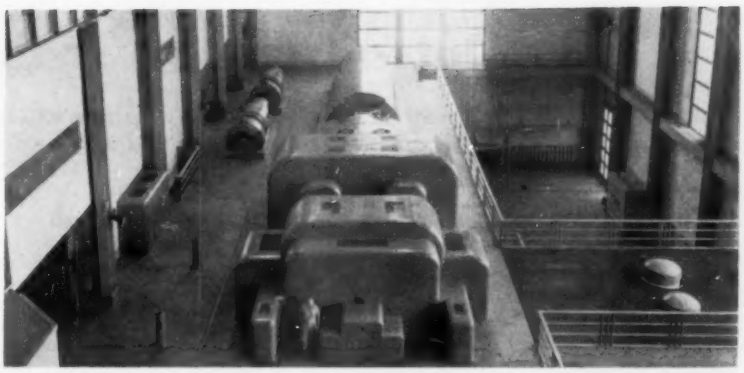


Fig. 2. General view of new 200,000-kw turbine generator Unit No. 7 at Burlington

Fig. 3. Central control room for Burlington Unit No. 7, showing curved console on which over 350 instruments and controls keep the operators constantly informed of operating conditions of boiler, turbine generator and auxiliaries

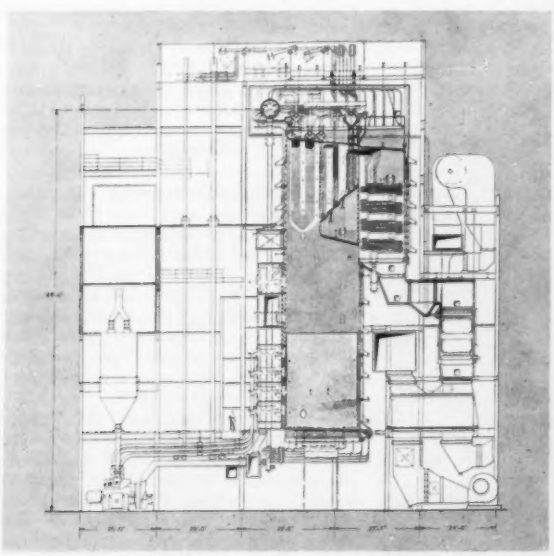


Fig. 4. General cross-section through Unit No. 7's pressurized boiler of 1,225,000 lb per hr output at 2400 psig, 1100 F

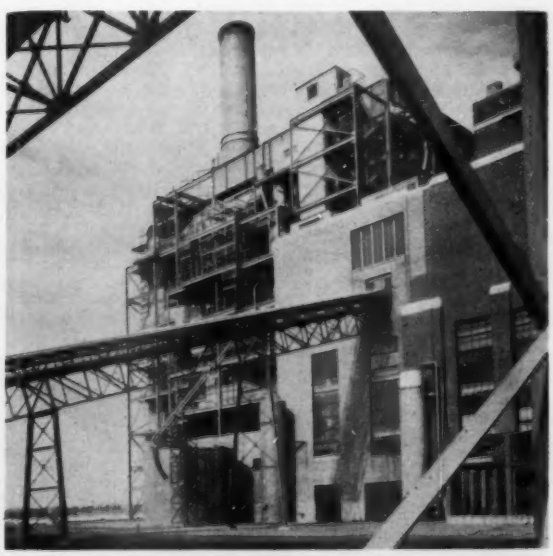


Fig. 5. General view of the pressurized furnace outdoor boiler for Unit No. 7, details of which are shown in Fig. 4

# How Detroit Edison Trains Operators For

**Problem is one faced by all utilities. How to train their operators to run complex new stations. Here are details of the method being successfully used by Detroit Edison Company for their new River Rouge Plant**

THERE WAS A TIME when an operator could transfer to a new station and learn his duties in a few days. Today this is almost impossible. The amount and complexity of equipment in a large modern station makes a long period of intensive training necessary before he is ready to handle the millions of dollars worth of equipment for which he is responsible.

The training scheme described here has been developed by E. V. "Dutch" Rieder, Superintendent of the River Rouge Plant, and his staff. It is being applied successfully by Detroit Edison Company in training operators for all their new stations. We will explain the method by showing how it is being applied at River Rouge Station.

Operator training started a long time before the station was ready to go into service. In the early days of construction, the station's future operators were selected, and throughout the building of the station, which has just gone into service, their training has been in full swing.

The first task was to acquaint the operators with every detail of the station, so they would be thoroughly familiar with the principles of operation and function of each piece of equipment in the plant. Arrangements were made to relieve them from their normal duties at other stations for a certain period each week so they could follow construction at River Rouge as it progressed.

To help them understand the operation of all the equipment in the plant, a series of Information Units were prepared. Each Unit was prepared as a separate booklet, as shown in Fig. 1, and we are showing the contents of one in full as an example of the method used in presenting this material. The one shown here — on chlorination — is a typical example, and the style of presentation is similar for all. It will be seen that the explanation is in elementary terms.

Similar Instruction Units have been prepared or are being prepared for the following subjects:

1. Extraction Heater Drains System — Level-Trol System
2. Control Air System
3. Steam Air Heating For Combustion Air
4. Turbine Oil Storage & Handling
5. Canal System For Circulating Water
6. Steam Generator No. 1
7. Gas Ignition System For Unit 1
8. Bottom Ash Handling System
9. Coal Handling System (2 Parts)
10. Blast Furnace Gas
11. Gas Ignition System For Unit 2
12. Steam Generator No. 2
13. Main & Aux. Electrical Systems
14. Turbine Gland Sealing System
15. Condensate Storage & Lubricating Water Systems
16. Turbine Control System Unit 1
17. Generator Cooling System
18. Fuel Oil Handling System
19. Flue Dust Collecting & Handling
20. Combustion Control System
21. Steam Temperature Control
22. Feedwater Control System
23. Auxiliary Steam System
24. Turbine Supervisory Instruments
25. Hydraulic Couplings
26. Steam Generator No. 3
27. Generator Field Excitation
28. Turbine Oil Supply System
29. Automatic Trips & Interlocks
30. Water Purification System
31. Turbine Gland Sealing System
32. Turbine Control System Unit 2
33. Combustion Control System
34. Steam Temperature Control
35. Feedwater Control System
36. Turbine Control System Unit 3
37. Turbine Gland Sealing System
38. Combustion Control System
39. Steam Temperature Control System Unit 3
40. Feed Water Control System
41. River Water Chlorinating System

The Job Training Units are also used afterwards to help operators in subjects on which they need more training.

Each operator is given a group of Job Training Units dealing with a subject in which he needs strengthening. He is then given two weeks to study the units, after which his supervisor sits down and discusses the units with him. When the discussion is complete, the supervisor enters a grade of *good* or *fair* on the operator's training record.

The Office Master Training Record is marked periodically to show the progress in training for each operator. Eventually all Job Training Units are completed by each man and all *fair* grades are repeated.

The second phase of training concerns the design features of the plant. Each week the operators meet as a group for a day. During the morning a member of the planning or design group gives a lecture on the design features of the plant. These lectures cover all phases of the plant. During the afternoon a representative of the Relay Division of the Electrical System gives a lecture on relaying and associated equipment.

The third phase will take place some time in the future, when discussions will be held between the operators, with the foreman as discussion leader, on details of operation. The operators will be responsible for writing a job training manual to detail each step of every job they might be called upon to perform. This will be the final formal step in the training.

Fig. 1. Work in progress on the 260,000 kw turbine generator set at River Rouge

# Their New Stations

Fig. 2. Part of River Rouge training scheme are these Job Instruction Units covering every phase of the station's operation. A typical Instruction Unit, on chlorination, is presented below to illustrate the simple explanations and clear diagrams used in these booklets

## Chlorinating System: Training Unit No. 41

**General:** Efficient means is supplied at River Rouge Power Plant to prevent sliming of condenser tubes and various equipment which take their suctions from the river. The river water at River Rouge is relatively high in organic and inorganic impurities, which comprise "slime." The most common form of slime is "vegetable slime," a combination of mud and silt bound together by algae or bacteria. Desliming can be considered as a sterilization process, for once the algae or bacteria is destroyed, the water velocity in the tubes will carry away any inorganic matter. Sterilization is accomplished by injecting a chlorine solution into the intake canal.

Our Wallace and Tiernan chlorinating equipment was designed to allow economical use of chlorine, which must be introduced in sufficient amounts to kill all organic matter and still maintain a slight excess of chlorine. This excess is called "residual chlorine" and insures that all organic matter has been destroyed. A residual chlorine recorder is located in the condenser room, and maintains a continual record of residual chlorine. The chlorine dosage is regulated so as to maintain the residual reading within the desired limits.

Several factors affect the chlorine dosage required:

1. Temperature of water.
2. Amount and type of impurities.
3. Reaction time (distance from chlorine diffusers to condenser.)
4. Rate of water flow.

It has been found that if chlorine is admitted at proper intervals and at proper dosages, organic matter is destroyed frequently enough to prevent excessive fouling of tubes. This intermittent use of chlorine represents a great reduction in the amount of chlorine required to maintain clean tubes. The frequency and amount of dosage must be determined by trial for each installation. Our chlorination units are capable of chlorinating at a maximum rate of 8,000 lbs. per day, each.

The sequence of operations of the chlorinator is controlled by a timer, which actuates valves through electric and pneumatic means. The sequence is as follows:

1. Priming period: General service water is admitted to the injector and the entire chlorinating piping from the chlorinator to the canal diffusers is filled with water.
2. Chlorination Period: Chlorine gas is admitted to the chlorinator. Rate of flow is determined by the rate controller, while period of chlorination is controlled by the timer.
3. Flushing Period: Chlorine is shut-off and water continues to flush out the chlorine solution lines.
4. Shut-down Period: Injector water supply is shut-off. System is ready for next chlorinating cycle, as determined by the timer program.

A description of what takes place

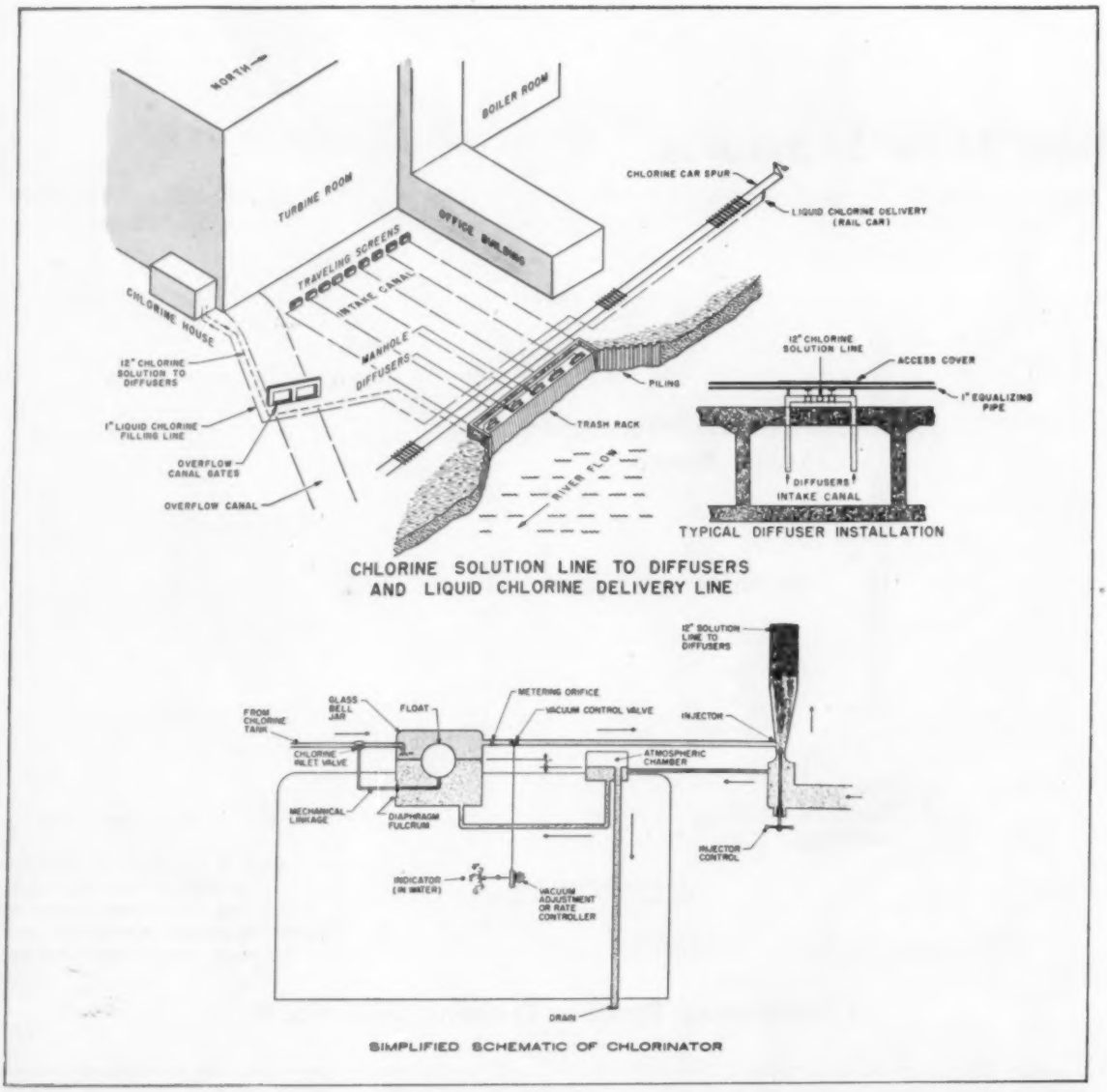



Fig. 3. Example of the type of diagrams and drawings used in the Instruction Units to illustrate text explanations

during the chlorinating period is outlined below, using Fig. 3 to illustrate the general theory of operation.

General service water enters the injector and discharges through the chlorine solution line and diffusers into the intake canal. A vacuum is created in the throat of the injector and draws chlorine gas from the bell jar through the metering orifice and the vacuum control valve. As chlorine is drawn off, the water level in the bell jar rises, and the float acts to open the chlorine inlet valve. Water for the bell jar is supplied from the atmospheric chamber, which is always at a constant level. Assuming our vacuum adjustment (rate controller) is set at 2", the water level in the bell jar will seek a level 2" above that in the atmospheric chamber. Chlorine gas will be admitted at a rate corresponding to the float position. Therefore, it can be seen that by increasing the vacuum the water in the bell jar will seek a higher level, resulting in a greater rate of chlorine flow, and vice versa.

The chlorinator is designed so that it is under a slight vacuum while chlorination is taking place. Chlorine gas is highly irritating to the skin, eyes, and respiratory system, and can cause death from suffocation in extreme cases. Any person working with chlorine should become thoroughly familiar with all safety precautions to be observed. Safety precautions are posted in the chlorine house, along with emergency first aid equipment. Three alarms are incorporated in the chlorine system and are located on the plant annunciator panel. One alarm is energized if the residual chlorine is too low or too high. The second alarm is a safety device which gives an alarm if free chlorine is escaping into the chlorine room. The third alarm is actuated by improper functioning of some part of the chlorinating equipment in the chlorine house.

The chlorinating house is located at the south east corner of the turbine house at ground level. Six chlorinators are installed each with its own "evaporator," which is merely a hot water bath for increasing the rate of flow of chlorine from the containers to the chlorinator. Chlorine is stored in fifteen one-ton containers. Chlorine can be delivered in these containers, but ordinarily, it will be delivered by rail car. A special rail spur, loading platform and a delivery line are provided for this purpose. (See Fig. 2.)

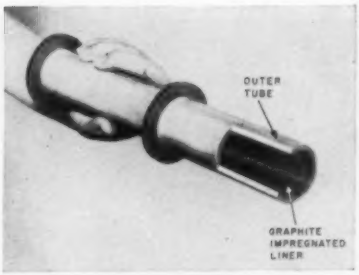
# Graphite-Impregnated Plastic Solves Precipitator Problem

IN AN ELECTROSTATIC precipitator, dust is pulled out of the gas stream by the action of the electric field through which it passes. The collected dust builds up on the plates and is generally removed by giving them periodic blows with a rapper. This often stirs up a local cloud of dust which results in a puff of fine dust being emitted from the stack.

With a new system developed by one of the country's leading precipitator manufacturers, this objectionable dust puff is eliminated by giving the plates small and frequent impulses instead of heavy and occasional impulses.

One of the problems in developing this system was the need for a hermetically-sealed hammer to apply impulses to the collecting plate at controlled intervals and which would be air tight for protection against the ever-present dust and from corrosion by the corrosive flue gases.

The cut shows how this problem was solved. The sealed hammer, which is solenoid operated, is enclosed in a tube of Synthane, a laminated plastic, which is lined with another layer of laminated plastic which has been impregnated with graphite. The lubricating effect of the graphite permits the hammer plunger to slide back and forth with very little friction.




Coil form in sealed rapper unit for new electronic rapping system for electrostatic precipitators. Outer tube of Synthane thermosetting laminate is designed to withstand frequent impulse stresses produced by plunger motion and high (2,000 volt) electrical stresses provided by current impulses in coil

Ordinarily laminated phenolic plastics are produced by a process of dissolving the plastic resin in a solvent and then impregnating a cloth with the dissolved resin. The solvent is then driven off by heating, leaving a cloth impregnated with resin. Sheets of this impregnated cloth are then put together in a stack or book which is cured under heat and pressure. In this process the resin polymerizes, producing a solid hard sheet of plastic laminate with a cloth core to give it tensile and impact strength.

Producing a plastic laminate impregnated with graphite to reduce friction can be done by coating the resin-impregnated cloth with graphite flakes, then laying these flake-covered sheets together and subjecting them to heat and pressure to cure the resin. However, this results in a plastic laminate in which the graphite particles are concentrated in a thin coating on each side of the cloth, thus providing a spotty lubrication effect.

Furthermore, the graphite particles readily flake off so that their lubricating effect is quickly lost from the laminated plastic material. With the new process the graphite flakes are dispersed throughout the plastic material and securely bonded into it, with the result that continuous lubrication is provided even as the laminate wears down.

The lining provides dependable lubrication for the life of the rapper, which can thus be built as a completely sealed unit.

---

# First Bare Aluminum Aerial Power Cable

BARE ALUMINUM has been used for the first time in the United States as aerial power cable sheathing in two 6,000-foot transmission lines at North Tonawanda, N. Y.

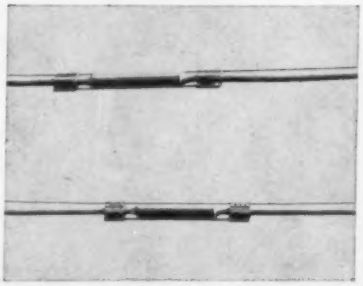
The use of aluminum in place of conventional lead produced a sheathing six times as strong and only a fifth the weight of lead.

The project was made possible by a new technique which permitted the aluminum sheathing to be joined with high strength welds without subjecting the cable insulation to elevated temperatures.

The splicing sleeve, of 3003 aluminum alloy, is 5 in. IPS by 0.258 in. wall by 32 in. long equipped with two filling bosses. This sleeve was joined to the ends of the cable sheath on each side of the splice by two aluminum bell shapes. One end of the bell shape was made to fit the inside of the flared cable sheath and the other end was made to fit the inside of the sleeve.

To simplify welding, the bells were made with a tapered wall ranging from 0.110 in. at the small end to 0.258 in. at the large end.

Before splicing, the splicing sleeve is slipped over one of the cable ends. The aluminum sheath ends are then flared to separate the sheath from the insulation about 5/16 in. A small amount of dry asbestos is packed between the cable insulation and sheath to keep oil from reaching the area of the weld. The bells are welded to the flared sheath ends. The insulated conductors are then joined in the usual way and the splice sleeve is slid into place and welded to the larger ends of the bell shapes.



*Courtesy, Aluminum Company of America*

Cable splices in center of span: extruded aluminum clamps with 7/16" messenger on top, 7/8" stainless steel alloy on bottom as stress bypass

The first U. S. installation of bare aluminum sheathed cable runs from a terminal station to a new transformer substation at North Tonawanda. From there a power system of 4,160 v distributes to customers in the western section of the city.

---

CORRECTION NOTE: It has been called to our attention that the article which appeared on page 79 of our February 1956 issue, entitled "How Much Reactance Do You Need for Safe Short Circuit?", was originally prepared by Amanda Conangla of I-T-E Circuit Breaker Co., and first published some time ago by *Electrical World*. We apologize to both Mr. Conangla and *Electrical World* for the unwitting use of this material without credit to them.

---

# Overhauling Turbine Generator Auxiliary

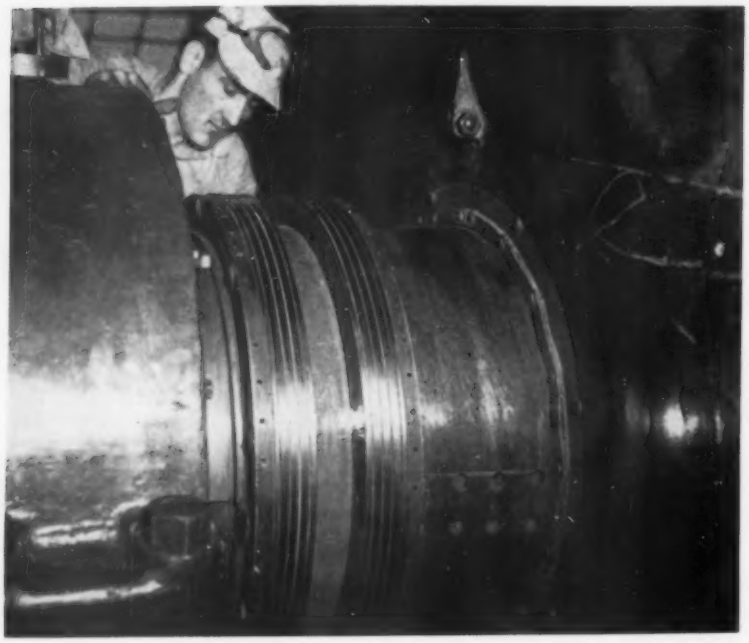


Fig. 1. Inspecting collector rings after they had been resurfaced by hand grinding

Fig. 2. Scraping slight ridges off bearing surfaces of generator half of coupling

**This is the fifteenth article in a series describing the scheduled overhaul of a 25,000 kw turbine generator at U. S. Steel Corp.'s South Works in Chicago.**

**Main Exciter:** The main exciter was completely overhauled. New bearings were installed, the commutator was resurfaced, the windings were checked and painted, and the insulation between the exciter frame and the base plate replaced.

**Generator Air Cooler:** The generator air cooler tubes were cleaned by shooting condenser plugs through them. The coolers were tested for leaking tubes with negative results.

**Transformers:** The transformers were cleaned and inspected. The oil was reconditioned by centrifuging and filtering before being replaced. The transformers were reassembled with new gaskets throughout.

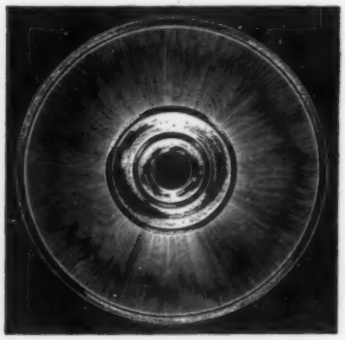
**Oil Switches & Disconnects:** The oil switches and disconnects were inspected and overhauled as required.

**Insulators:** All insulators in the switch yard were cleaned with steel wool.

**Generator Collector Rings:** The generator collector rings were resurfaced by hand stoning when the unit was being brought up to speed as shown in Fig. 1.

**Instruments:** All electrical instrumentation and control were checked and calibrated to insure accurate and dependable service.

**Turbine Generator Coupling:** The turbine-generator coupling was carefully inspected. The contact surfaces



When all these articles have been published the series will be reprinted. To reserve one or more copies of the reprint write to the Editor

were scraped and honed to ensure even bearing as shown in Fig. 2.

**Thrust Bearing:** The thrust bearing was removed from the spindle shaft and dismantled. The thrust collar and shoes were carefully inspected for proper bearing and possible scoring, as shown in Figs. 3 and 4. In reassembling the thrust bearing the shims were adjusted to provide proper clearance.

The turbine thrust adjusting gear was overhauled and checked for free operation. This gear is used to position the spindle during start-up or shut-down.

**Governor:** Inspection of the governor shown in Fig. 5 revealed an excessive amount of lost motion so it was returned to the manufacturer for a complete overhaul and calibration. Excessive backlash was found in the worm and governor and oil pump gears so they were replaced.

**Auxiliary Motors:** All motors driving auxiliary equipment were dismantled, cleaned and carefully inspected. Where necessary, bearings were replaced, insulation repaired and repainted and coupling alignment checked.

**Gages:** All gages, flow meters, instruments and thermometers were overhauled or replaced and calibrated to ensure accurate and dependable service.

**Safety Devices:** The safety devices such as the overspeed trip, low oil pressure trip, solenoid operated trip as well as heat exchanger safety valves and the alarm system were carefully overhauled and checked before the unit was placed in service.

Fig. 4. Inspecting thrust bearing shoes for proper contact with their thrust collar

Fig. 3. Thrust bearing shoes shown in place in Fig. 4 carefully laid out on wiping towels for cleaning and inspection

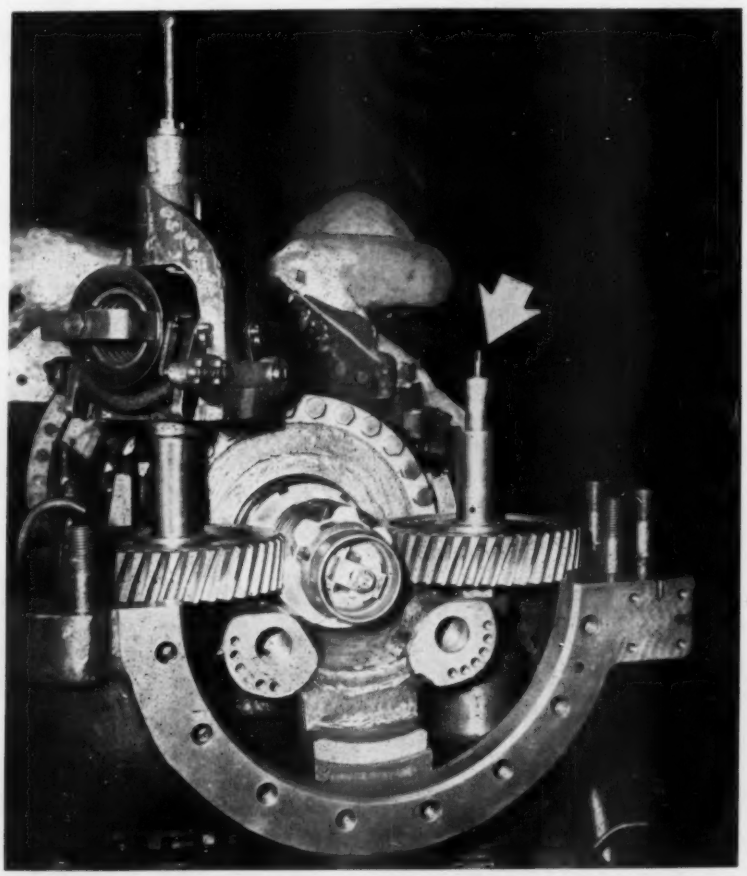


Fig. 5. Partly dismantled turbine governor. Arrow points to spindle used for driving main oil pump. Photo shows how governor and oil pump are both driven through gears from a worm wheel mounted directly on main turbine shaft

Power Engineering handbook

# Two Good Ways To Handle Temperature Variations in Control Systems

BY JOHN M. DEABELLE

WHEN COLD weather sets in, plants using outside storage of fuel oil frequently encounter trouble caused by high viscosity and subsequent low oil pressure at the burner tips. Installation of a storage tank fuel oil heater does not alone solve this problem. Unless temperature controls, activated by the oil supply temperature, are used to govern the heating, either variations in the quality of steam supplied such heaters or variations in the initial oil temperature will produce closely corresponding effects on the oil viscosity.

### Oil Heater Control

Since the installation of temperature controls is so simple, it is more difficult to justify omitting them than it is to justify their inclusion in the design. Figure 1 shows how this can be accomplished inexpensively to produce relatively constant temperatures and thereby viscosities.

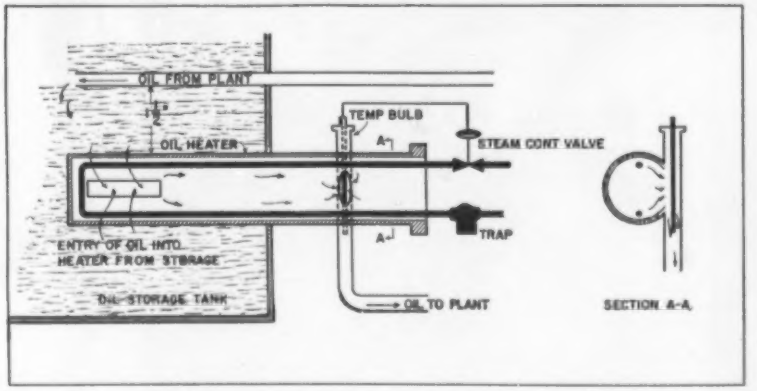



Fig. 1. Fuel oil heater with temperature control from temperature bulb inserted in the oil suction line



fold along this line—outside edges toward you

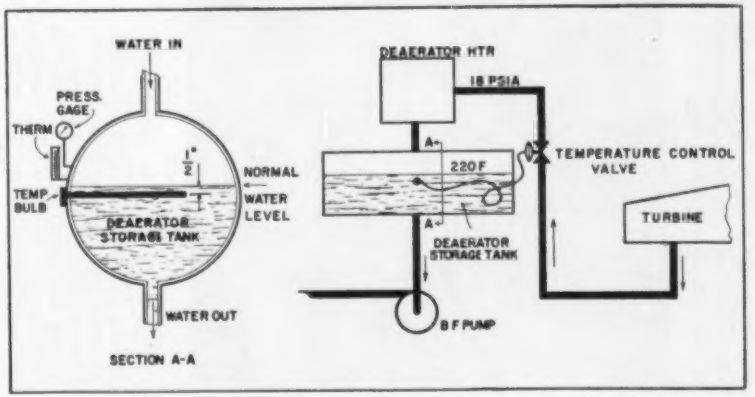



Fig. 2. Control on the deaerator storage tank protects the boiler feed pump from varying pressures

In these oil heater installations, oil is drawn from the heater through a pipe which intersects the heater tangentially. A temperature bulb is fitted into this tangential pipe, so that it extends beyond the opening. Note that the temperature bulb is not inserted into the heater proper, but is in the suction line coming out of the heater where fluid velocities are higher and a truer indication of the actual oil supply temperature is possible. The temperature bulb is connected directly to a steam control valve in the steam line immediately before the heating steam enters the oil heater.

If the oil burner is operated on the return line system (where the pump output is constant and excess fuel is re-circulated back to the storage tank), oil returned from the plant should be introduced into the oil storage tank about 1½ in. above the oil heater, so that heat remaining in this oil will provide supplementary heating to that provided by the steam.

### Deaerator Control

Figure 2 shows how one power plant solved the problem of surges and wide temperature variations in the deaerator storage tank. The deaerator steam comes from an extraction stage of the main turbine at 18 psia, and water in the storage tank flows down to the boiler feed pump below it.

When the temperature of water stored in the deaerator tank varies widely, storage tank pressure varies as well. This produces serious effects in the feed pump and makes control of the entire system unstable.

The problem was solved in this case by installing a temperature bulb near the water surface in the storage tank. This bulb was installed through the side of the tank so that it projected into the water about ½ in. below water level, which was held substantially constant by controls on the deaerating heater, as shown in Section A-A of Fig. 2.

The bulb in turn actuated a diaphragm valve in the extraction steam line to the deaerating heater and was so adjusted that only enough steam was admitted to maintain water temperatures of 220 F. where the water emerged from the deaerating heater. This temperature was suitable for this particular installation, but would have to be varied to fit into the particular steam cycle if applied to other plants.

It should be remembered that maintaining a constant temperature at the surface of the storage tank will result in a constant vapor pressure above the surface. If this storage tank pressure is properly calculated, and the extracted steam is at sufficiently high pressure under low-load conditions, no cavitation of the boiler feed pump should be encountered.

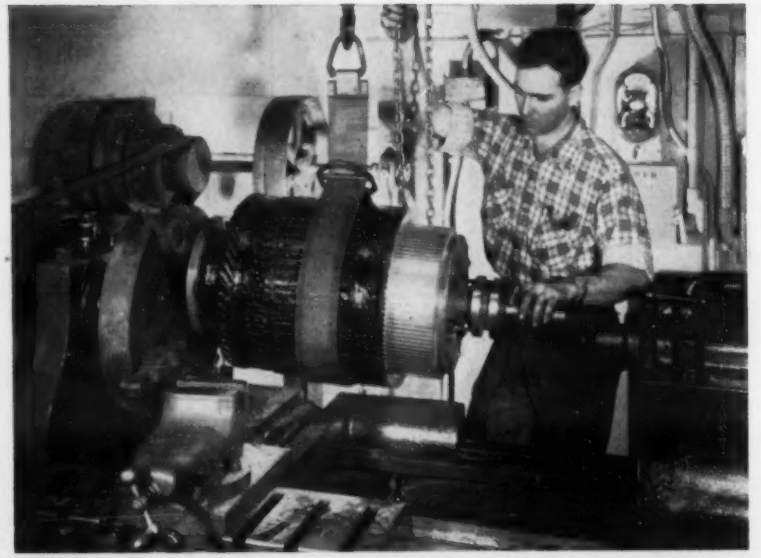


Fig. 1. Gripper Sling capacities range up to 100,000 lb on the standard models. Special sizes on order

# Sling Eases Equipment Handling

BASICALLY, this stainless steel gripper sling is similar to a woven wire conveyor belt but with a handle attached to each end. This new tool, known as the Gripper Woven Wire Sling, is being used for lifting almost any kind of equipment or material.

The construction is a series of spiraled wires joined together across the body of the sling. This allows the sling to bend completely back on itself, assuring a tight grip and preventing the load from slipping.

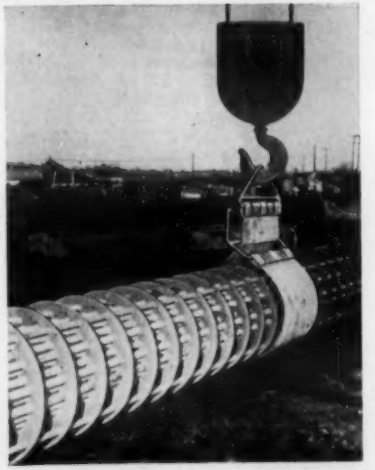


Fig. 2. (Right) Sling being used in the handling of heat exchanger tube bundles at an oil refinery

**FOR MORE INFORMATION . . .**

Write the Editors, or jot "Gripper Sling" on the postcard inserted elsewhere in this issue, and mail.



fold along this line—outside edges toward you

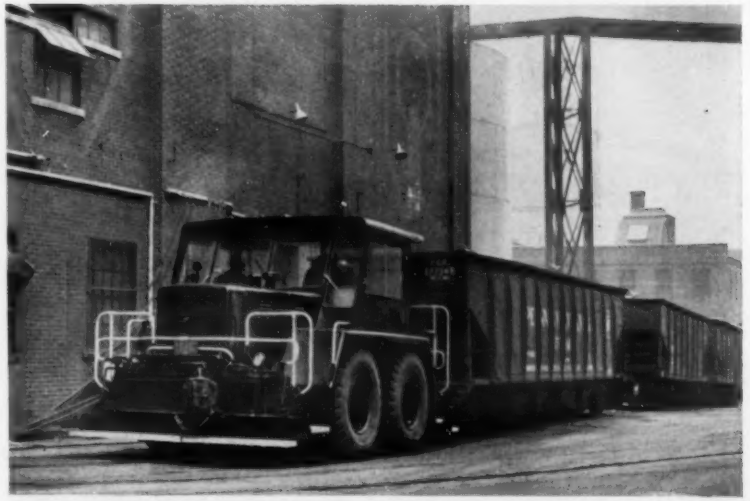


Fig. 1. The new Switchmobile couples to cars in standard railroad procedure, but travels streets also

# New Rubber-Tired Switch Engine

Fig. 2. Both-ways-forward feature is accomplished by use of pivoted controls which swing laterally from a pedestal located at the center of the cab

BUILT FOR THE Pennsylvania Railroad by Le Tourneau-Westinghouse, the new "Switchmobile" is said to be the first machine of its kind. It climbs across tracks, travels on city streets and also pulls freight cars along the tracks like a locomotive. A wheel gauge of 8-ft 4½-in. allows it to straddle rails and run on ties, as well as operating on pavement flush with rail tops when pushing or pulling cars.

Power is equal to a 50-ton conventional switch engine, although the Switchmobile weighs less than 36,000 lb. The machine can pull as many as 8 loaded freight cars along the rials easily. Size is 10-ft 3-in. wide by 10-ft 13-in. high. Length from coupler to coupler is only slightly longer than a standard passenger automobile.

A special 4-speed transmission offers the same gear ratios in both directions, so the Switchmobile pulls or pushes with equal power and speed in either direction. A separate lever, independent of the gear change, allows quick and easy shifting from forward to reverse. This control arrangement is mounted in the cab as shown in Fig. 2

Power Engineering handbook

# Two Good Ways To Handle Temperature Variations in Control Systems

BY JOHN M. DEABELLE

WHEN COLD weather sets in, plants using outside storage of fuel oil frequently encounter trouble caused by high viscosity and subsequent low oil pressure at the burner tips. Installation of a storage tank fuel oil heater does not alone solve this problem. Unless temperature controls, activated by the oil supply temperature, are used to govern the heating, either variations in the quality of steam supplied such heaters or variations in the initial oil temperature will produce closely corresponding effects on the oil viscosity.

### Oil Heater Control

Since the installation of temperature controls is so simple, it is more difficult to justify omitting them than it is to justify their inclusion in the design. Figure 1 shows how this can be accomplished inexpensively to produce relatively constant temperatures and thereby viscosities.

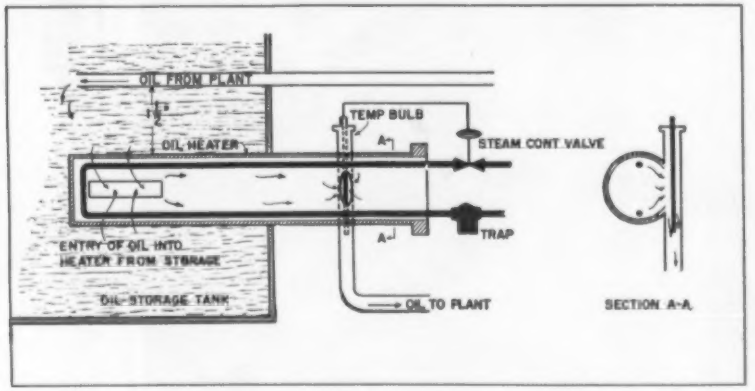



Fig. 1. Fuel oil heater with temperature control from temperature bulb inserted in the oil suction line



fold along this line—outside edges toward you

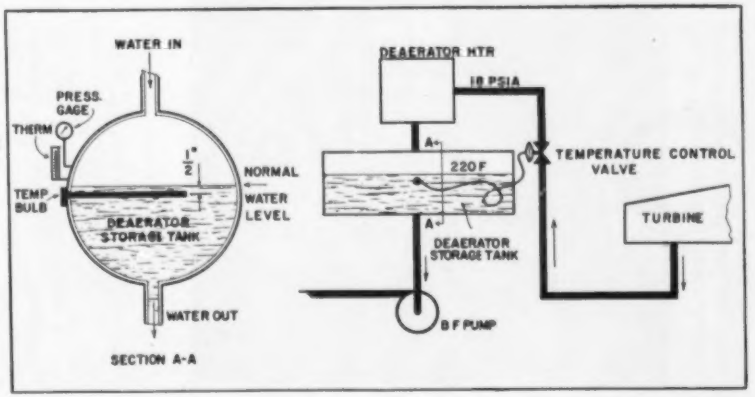



Fig. 2. Control on the deaerator storage tank protects the boiler feed pump from varying pressures

In these oil heater installations, oil is drawn from the heater through a pipe which intersects the heater tangentially. A temperature bulb is fitted into this tangential pipe, so that it extends beyond the opening. Note that the temperature bulb is not inserted into the heater proper, but is in the suction line coming out of the heater where fluid velocities are higher and a truer indication of the actual oil supply temperature is possible. The temperature bulb is connected directly to a steam control valve in the steam line immediately before the heating steam enters the oil heater.

If the oil burner is operated on the return line system (where the pump output is constant and excess fuel is re-circulated back to the storage tank), oil returned from the plant should be introduced into the oil storage tank about 1½ in. above the oil heater, so that heat remaining in this oil will provide supplementary heating to that provided by the steam.

### Deaerator Control

Figure 2 shows how one power plant solved the problem of surges and wide temperature variations in the deaerator storage tank. The deaerator steam comes from an extraction stage of the main turbine at 18 psia, and water in the storage tank flows down to the boiler feed pump below it.

When the temperature of water stored in the deaerator tank varies widely, storage tank pressure varies as well. This produces serious effects in the feed pump and makes control of the entire system unstable.

The problem was solved in this case by installing a temperature bulb near the water surface in the storage tank. This bulb was installed through the side of the tank so that it projected into the water about ½ in. below water level, which was held substantially constant by controls on the deaerating heater, as shown in Section A-A of Fig. 2.

The bulb in turn actuated a diaphragm valve in the extraction steam line to the deaerating heater and was so adjusted that only enough steam was admitted to maintain water temperatures of 220 F. where the water emerged from the deaerating heater. This temperature was suitable for this particular installation, but would have to be varied to fit into the particular steam cycle if applied to other plants.

It should be remembered that maintaining a constant temperature at the surface of the storage tank will result in a constant vapor pressure above the surface. If this storage tank pressure is properly calculated, and the extracted steam is at sufficiently high pressure under low-load conditions, no cavitation of the boiler feed pump should be encountered.

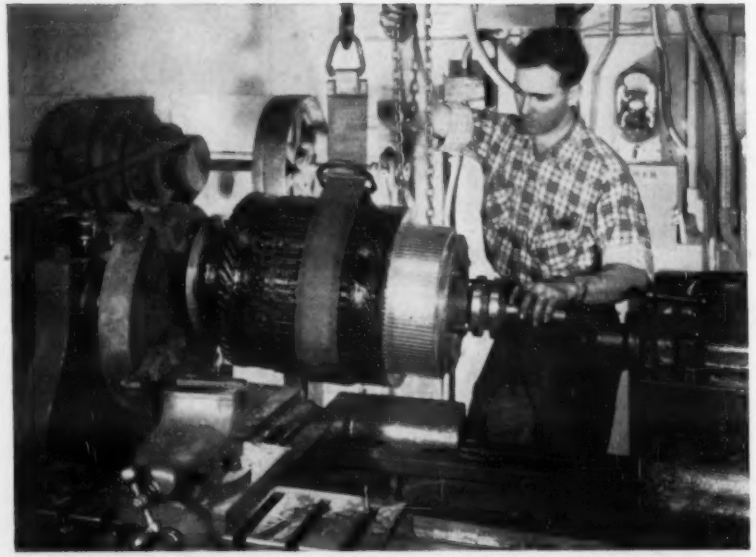


Fig. 1. Gripper Sling capacities range up to 100,000 lb on the standard models. Special sizes on order

# Sling Eases Equipment Handling

BASICALLY, this stainless steel gripper sling is similar to a woven wire conveyor belt but with a handle attached to each end. This new tool, known as the Gripper Woven Wire Sling, is being used for lifting almost any kind of equipment or material.

The construction is a series of spiraled wires joined together across the body of the sling. This allows the sling to bend completely back on itself, assuring a tight grip and preventing the load from slipping.

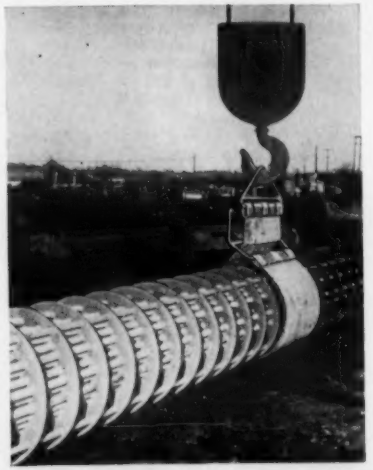


Fig. 2. (Right) Sling being used in the handling of heat exchanger tube bundles at an oil refinery

**FOR MORE INFORMATION . . .**

Write the Editors, or jot "Gripper Sling" on the postcard inserted elsewhere in this issue, and mail.



fold along this line—outside edges toward you

Fig. 1. The new Switchmobile couples to cars in standard railroad procedure, but travels streets also

# New Rubber-Tired Switch Engine

Fig. 2. Both-ways-forward feature is accomplished by use of pivoted controls which swing laterally from a pedestal located at the center of the cab

BUILT FOR THE Pennsylvania Railroad by Le Tourneau-Westinghouse, the new "Switchmobile" is said to be the first machine of its kind. It climbs across tracks, travels on city streets and also pulls freight cars along the tracks like a locomotive. A wheel gauge of 8-ft 4½-in. allows it to straddle rails and run on ties, as well as operating on pavement flush with rail tops when pushing or pulling cars.

Power is equal to a 50-ton conventional switch engine, although the Switchmobile weighs less than 36,000 lb. The machine can pull as many as 8 loaded freight cars along the rials easily. Size is 10-ft 3-in. wide by 10-ft 13-in. high. Length from coupler to coupler is only slightly longer than a standard passenger automobile.

A special 4-speed transmission offers the same gear ratios in both directions, so the Switchmobile pulls or pushes with equal power and speed in either direction. A separate lever, independent of the gear change, allows quick and easy shifting from forward to reverse. This control arrangement is mounted in the cab as shown in Fig. 2

Fig. 1. New unit from Hilti is supplied in five types, price range from $17.65 to $33.75 with tool chest

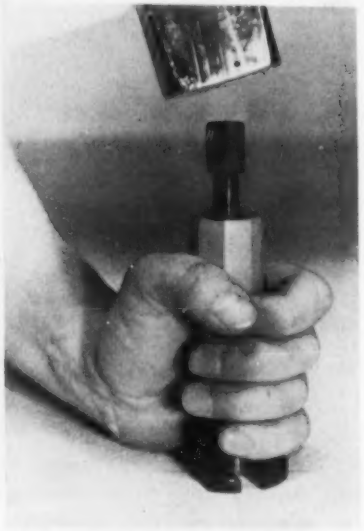


Fig. 2. Only power needed to penetrate steel is a few strokes from a two- or three-lb hammer

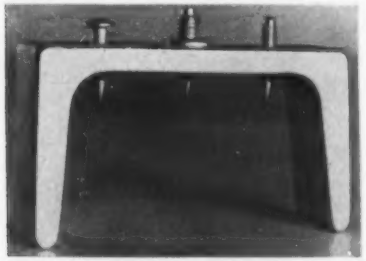


Fig. 3. Model shows results of Hilti fastener tool used to drive different studs through steel bar

**WANT MORE INFORMATION?**

For more details on these important new hand-powered tools, write the Editors or jot Hand-Powered Fasteners on the prepaid postcard elsewhere in this issue.

# Two New Fastener Tools Use Only Hammer Strokes to Drive Studs

TWO IMPORTANT new hand tools have just been introduced on the market and will simplify shopwork of all kinds by filling in the gap between very light hammer-and-nail fastening and heavy-duty power-actuated tools. Both of these new fasteners are low in cost, under $35. One is called the Hilti Rapid Fastener, shown on this page; the other is called Shure-Set, and is shown on the opposite page.

The Hilti tool is designed so that its ballistic point assures easy penetration. Its conical shaft is described as giving very high pull-out resistance.

The tool is available in five different types for use with various types of studs, and may be obtained in kits ranging in price from $17.65 to $33.75. The de luxe DM6 unit has tool chest, with 3 rings to control penetration, 2 sets of jaws, a 2½-lb. hammer and a key for ¼-in. hex nuts. The $17.65 kit includes a unit for narrow channel work.

Hilti has made a cost comparison study, which showed that the subject job — fastening clamps on a concrete column in a machine shop — was performed at a cost of $1.56. This consisted of driving 100 studs during a ½-hour period, at $3.125 an hour.

The Shure-Set tool (above) is gripped tightly in the center, then hit on the top rod with a hammer. The base plate is designed to level the tool at right angles to the work and to protect the surface from mis-aimed hammer blows. The hammer action seats a fastener into a variety of materials including light steel, concrete, concrete block, cinder block, Haydite, mortar joints, brick.

Shure-Set has two main groups of fasteners: the drive pins which sell from $5.25 to $12.25 a hundred, and threaded studs which are priced at from $7.50 to $10.50 a hundred. The drive pins come in lengths from ¾ in. to 3 in., while threaded studs range from ⅜ in. to ⅝ in., with shanks of varying lengths. The drive pins are for permanent installations and those with screw heads for temporary installations.

The tool is capable of using a variety of fasteners in the ½-in. and 3/16-in. sizes, and change over from one to the other is simple. The tool's leveling plate is detachable, making it possible for fastenings to be placed in corners and out-of-the-way places. The leveling plate protects the user from flying splinters; and the hand guard prevents mashed fingers.

Shure-Set is simple to use. The rear rod is pulled out to a designated point. The fastener is placed in the opposite end with point sticking out. The point of the fastener is placed on the precise point where the fastening is to be made. The rear rod is pressed down as far as it will go. The anvil rod is hit sharply with a hammer three or four times.

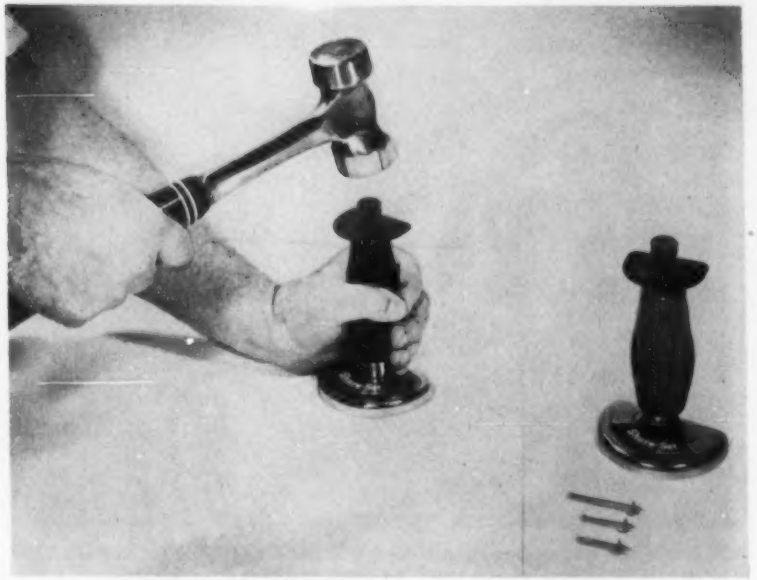
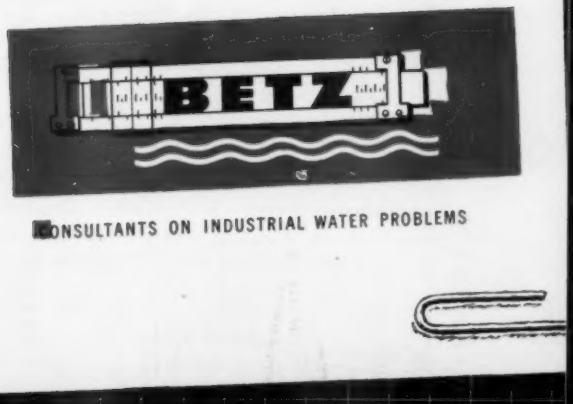
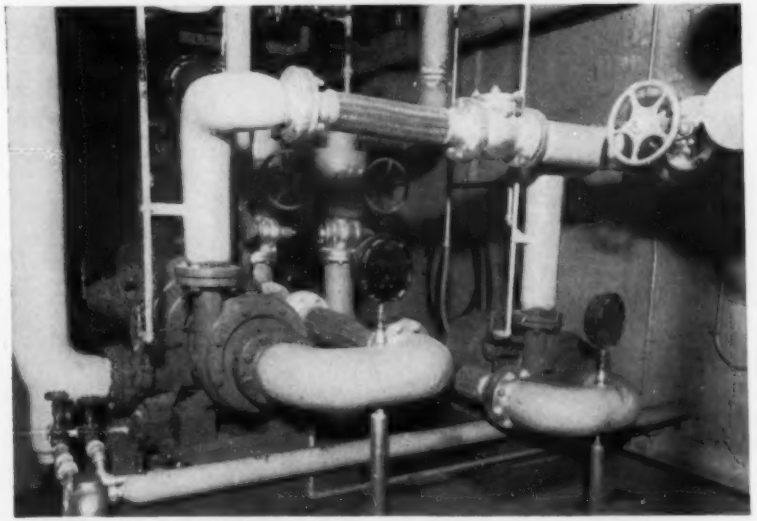


Fig. 4. New Shure-Set unit sells for $27.95, has long and short collars, two sizes of holders, studs in kit

*In water conditioning... there's one way to be sure!*




*W. H. & L. D. BETZ, Philadelphia, Pa.*



FLEXIBLE METAL HOSE used at suction and discharge is an economy-wise feature of the two moderate-speed centrifugal pumps which handle boiler feed water in the new Community Memorial General Hospital in La Grange, Ill. Made by Ingersoll-Rand, both of these units are close-coupled, vertically-split-case pumps, incorporating low cost with space and weight advantages. Each can deliver 32 gpm of 220 deg F. water against a discharge head of 350 ft. Metal hose is from the Chicago Metal Hose Co.

# Easy-To-Make Pressure Gage Markers

By F. E. RILEY

MAINTENANCE AND reconditioning work on diesel engine fuel injection gear often requires that a pressure drop between two positions on the gage be timed; as, for example, when it is desired to time the rate of leakage between an injector needle valve and its seat.

Testing is much more accurate if some marker is fitted to the pressure gage, indicating the top and bottom limits of the pressure range. Suitable markers can be made up from small pieces of strip steel bent so that they will spring over the width of the pressure gage body, and can be adjusted easily for position around the gage periphery.

Instead of memorizing a pressure range, or writing it down on a piece of paper which may become lost, the indicators are set so that the user of the gage can see at a glance where the pointer ought to be positioned.

Fig. 1. Depth of erosion pit holes in boiler tubes can be accurately measured with this instrument



# Two Useful Ideas from Navy Engineers

ENGINEERS AT THE Boston and New York Naval Shipyards are responsible for the developments pictured on this page, as reported in the Bureau of Ships *Journal*.

Shown above is a measuring tool designed to determine the extent of erosion damage in boiler tubes. Its use eliminates the guesswork of visual inspection.

Below (Fig. 3) is shown a Teflon plug used instead of a synthetic rubber grommet for the electrical insulation in nozzle switch housing on gasoline systems. The grommet shorted out electrically when the nuts were tightened, also had insulation resistance of only 50 to 1,000 ohms.

To replace the defective grommets, a ⅛-in. pipe plug was made from Teflon, whose electrical insulation properties give the plug a resistance of over 100,000 ohms, and which allows the system to operate properly. The hole for the control pin was drilled 0.008-in. undersize for a press fit. The pin was placed in the tapered plug before the plug was screwed into the casting. When the nuts were pulled tight, the plug expanded into the hole and gave the threaded portion a liquid- and gas-tight seal.

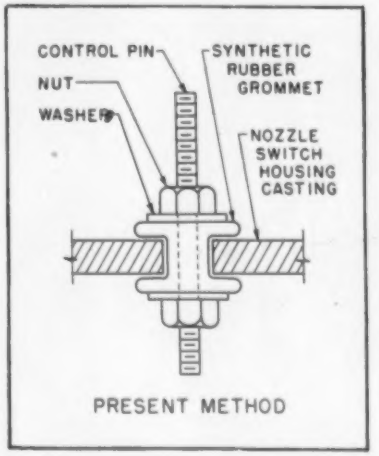



Fig. 2. Synthetic rubber grommet for insulation

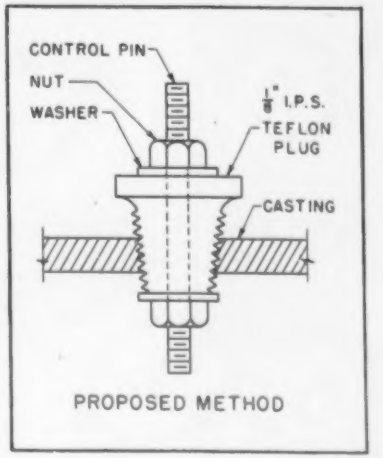


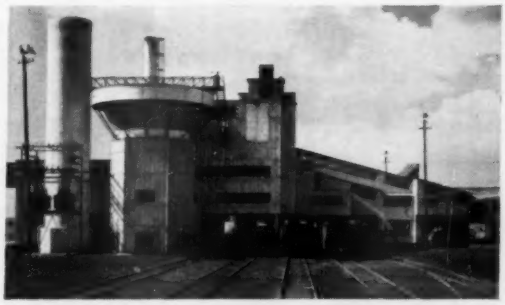

Fig. 3. Teflon plug is tapered to fit the casting

# Why pay freight for ashes and water ?

You're buying BTU's—not bulk—when you specify free-burning, low ash BUCKHORN from Bell & Zoller's Southern Illinois fields. Every ton is *superwashed* to remove non-burning debris . . . heat dried to a low, even moisture content before loading. Extra BTU's replace the waste removed from every ton you receive.

BUCKHORN makes a perfect "prescription coal" too—firm-structured, carefully screened and blended to your exact burning requirements.

It's shipped via Illinois Central, CB & Q, C & EI, Missouri Pacific routes. Order BUCKHORN through your nearest Bell & Zoller office.



Buckhorn Mine with modern washer, Williamson County, Illinois. Daily capacity: 5,000 tons No. 6 seam coal.

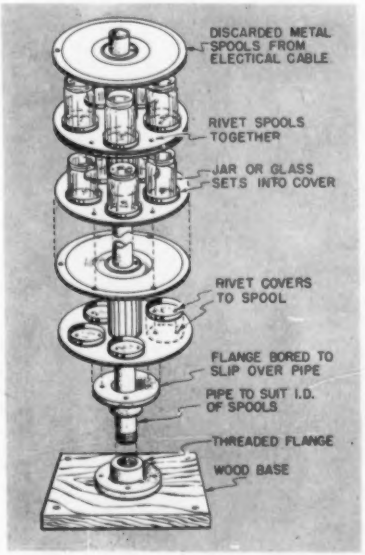
**Bell & Zoller Coal Company**

70 YEARS OF SERVICE TO COAL USERS

BELL BUILDING, CHICAGO 1, ILLINOIS

Detroit • New York • St. Louis • Minneapolis
Omaha • Milwaukee • Louisville • Washington, D.C.
Terre Haute, Ind. • Mount Hope, W.Va.

For more data circle 549 on Post Card

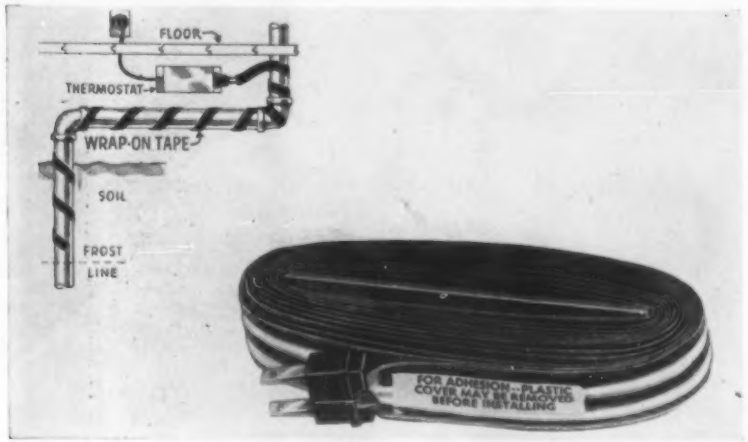

DISCARDED METAL SPOOLS FROM ELECTICAL CABLE
RIVET SPOOLS TOGETHER
JAR OR GLASS SETS INTO COVER
RIVET COVERS TO SPOOL
FLANGE BORED TO SLIP OVER PIPE
PIPE TO SUIT I.D. OF SPOOLS
THREADED FLANGE
WOOD BASE

Home made, but a good small parts turn-table, where everything is in sight and easily at hand

## Cable Spools Make Lazy Susan

THERE'S a handy use for those well-made spools that flexible wire cable comes on — and most plants collect plenty in the course of time. The sketch shows how a Lazy Susan can be made to accommodate small glass jars saved from the kitchen department, together with tin can covers or large jar covers. The covers are spaced around the spool, riveted on, and the jars are set into the covers so that they will be held in place as the Lazy Susan is turned.

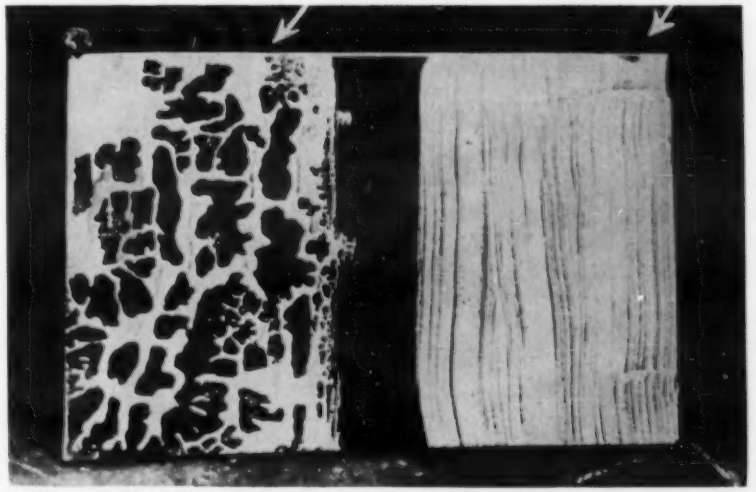
In the model shown here, the three spools are riveted together so all turn at once. A dished washer under the bottom spool makes turning easy. The whole is assembled on a section of pipe into a flange, and attached to a base on the bench.




This self-adhesive electric heating tape is installed simply by peeling off its polyethylene covering and pressing tape against pipe. Available in 3, 6, and 13-ft. lengths with 15, 30 and 60-watt capacities respectively at 115 v (a-c), from Wrap-On Co. The plug may be used with any household electric outlet







There is no point in brazing a joint which you know will be weak. If the flux leaves islands of unwetted surface (above left), the brazing metal will adhere in a spotty pattern. Flux does a good job of removing thin films of oxide and oil (right), but extremely dirty surfaces will be only partially cleaned off

## Check Flux Adhesion for Braze Joints

GIVEN a well-cleaned, fluxed surface to work on, silver brazing alloys will wet easily to produce strong, leak-tight joints. Flux helps the molten alloy wet metals by reducing surface tension and by removing and inhibiting oxidation. But unless the flux itself wets the metal initially, there is little chance that the brazing alloy can do so. (This does not apply to the special alloys developed to silver-braze copper without flux.)

Flux is compounded to remove a certain amount of metal oxides, and contains a wetting agent to help break up thin films of oil such as are commonly encountered on mill supplied materials. However, when the accumulations of dirt, grease, oil and oxides become excessive, they can retard wetting by both the flux and alloy. Consequently you can often predict if the brazing alloy is likely to wet by examining the way the flux adheres to a surface.

To illustrate this point, technicians at the engineering laboratory of a manufacturer of silver brazing alloys and fluxes, took a thoroughly oily steel plate which was lying around the shop, cleaned and degreased one half of the plate; the other half they left intact. They then applied a standard flux to each half. The results are shown above.

Note the even coating of flux on the cleaned half, and the flux-less islands on the oily half. If brazing were attempted on a piece in the latter condition, the alloy would wet so sparsely that a mechanically weak and probably leaky joint could be expected. If the flux wets poorly, the wisest and most economical thing to do is to clean and degrease the pieces before attempting to braze them.

The usual cleaning procedure is to degrease in a vapor degreaser or suitable solvent. Then remove any oxide by pickling or by touching the piece to an abrasive belt or wheel. When handling cleaned parts, do not touch the joint faces; a greasy fingerprint is as much of an offender as a patch of oil or oxide.

Information and photograph courtesy of Handy & Harman.

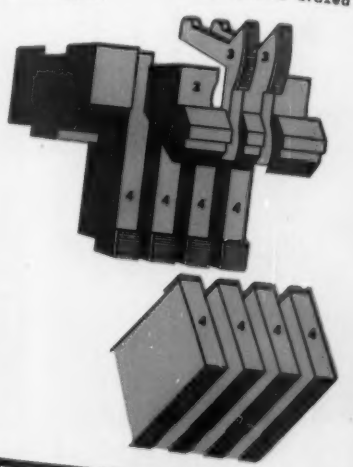
G-E Type AK-1-50 Electrically Operated Air Circuit Breaker, 1600-amperes, 600 Volts, A-C. One pole shown. Made by General Electric Company, Low Voltage Switchgear Department, 6901 Elmwood Ave., Philadelphia, Pa.

Here is the General Electric Type AK-1-50 Electrically Operated Air Circuit Breaker, 1600-ampere frame size used to protect low-voltage systems. The picture shows one pole of the contact, and in order to photograph it, the housing and the arc-quencher parts were removed. Note the Revere Extruded Shapes, and Rectangular Rod. There are three shapes, and one size of bar, all in copper, because copper has the highest electrical conductivity of all commercial metals.

If these shapes had to be "hogged" out of bar, they would be expensive, due to the machining time, and the scrap generated. While copper scrap is readily salable at good prices, it is costly from the machining standpoint. Extruded shapes by Revere, preformed to the desired contours, usually reduce machining to a cutting-off operation, plus such minor details as drilling which cannot be done during extrusion. Shapes naturally cost more per pound than bar or rod, but the ultimate saving makes up for the difference and more, sometimes several times.

Are you doing much machining of copper? If so, look into Revere Extruded Shapes. They may save money, and speed up production as well. See the nearest Revere Sales Office.

Sketch showing details of contacts. Nos. 1, 2 and 3 are extruded and drawn copper shapes. No. 4 is rectangular copper bar. Cross hatching represents special arcing contacts brazed to the copper.



**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

230 Park Avenue, New York 17, N. Y.

• • •

*Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. —Sales Offices in Principal Cities, Distributors Everywhere*

**For more data circle 550 on Post Card**

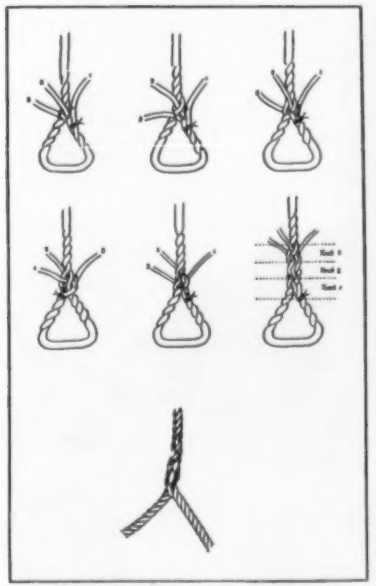


Fig. 1. Drawings illustrate steps in making eye-splice. Read with numbered steps described below

Fig. 2. An eye may be spliced about a thimble to provide protection from wear when rope is in use

# How To Make An Eye-Splice

ONE OF THE handiest things to know in and around a plant is how to splice rope. Splicing not only provides a permanent junction but also a stronger connection in any rope. These directions for making a good splice come from the New Bedford Cordage Co. in Massachusetts.

(1) "Whip" or bind the end of each strand of rope with string or twine to prevent unraveling.

(2) "Unlay" or unwind the rope about six turns, or the length of six diameters. Some riggers whip rope at this point.

(3) Twist the rope open at the point where the inlaid strands are to be tucked in.

(4) At the untwisted point, drape one of the unlaid strands on either side of the rope and place one in the middle along the rope.

(5) Insert a fid, or tapered wooden pin, under the top strand where the rope was untwisted. Hold open with thumb and forefinger and withdraw fid.

(6) Pass the end of the unlaid center strand through the opened strand. Pull through and tighten.

(7) Open the strand to the left and tuck in left-hand unlaid strand. Open the strand to the right and tuck in right-hand unlaid strand.

(8) Repeat steps six and seven a second time.

(9) Repeat a third time. For a tapered splice, after finishing the second tuck, cut about half the yarn from the unlaid strands and make the third tuck with the halved strands. Cut the strands in half again and make a fourth tuck. Trim off ends.





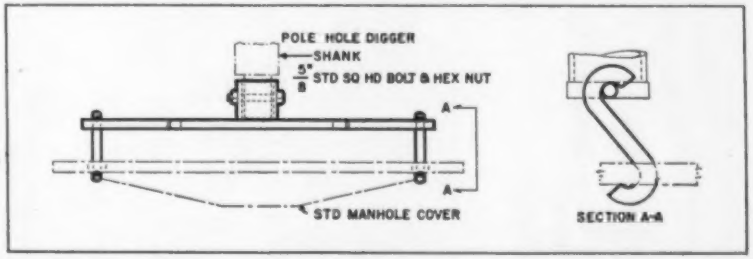



Fig. 1. Head of pole hole digger is removed and bar with hooks attached in its place with bolt. Short section of pipe is welded to the center of the bar. Fig. 2 (right) shows construction of attachment at A-A

# Silencing Noisy Manhole Covers

By M. F. Wright

WOBBLY, NOISY manhole covers can become a real nuisance to large industries as well as to utilities companies. Warpage of the cast iron cover, especially in winter, and heavy traffic over it, cause the trouble. The best cure is to grind the castings for a close fit, and the simplest way to do this is to revolve the cover over the manhole casting seat, grinding to fit in place, without removal.

Figs. 1–4 show how a cover-revolving attachment will do the job. It is in the nature of a simple bar and hook arrangement. A short section of pipe is welded to the center of the bar for attachment by means of a 5/8-in. bolt to the bottom stub of the revolving shank or post of a pole hole digger mounted on the back of a pole line truck. The drill portion is disengaged and the bar installed in its place. The truck is then driven over the manhole to be ground, and the post and arm are centered over the manhole cover. The bar is then lowered over the cover and the two S-hooks engaged into the two lifting holes of the cover and on the arm.

The cover is lifted clear of the seat by means of the pole digger post, arm and hooks. Suitable coarse grinding compound is spread over the seat, the cover lowered and rotation of the grinding assembly started. At predetermined intervals the rotation is stopped and the cover tested for wobbling. If more grinding is needed, more abrasive compound is added.

At the completion of the job, the pole digger is restored to its original condition by replacing the digger head.

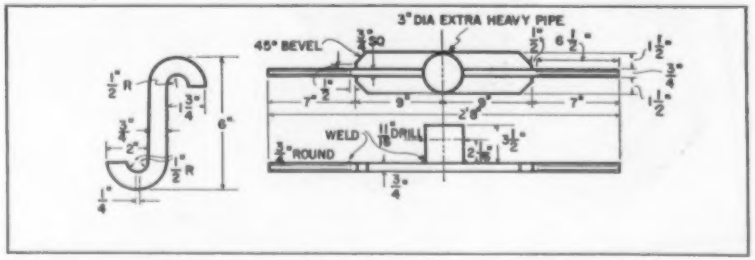
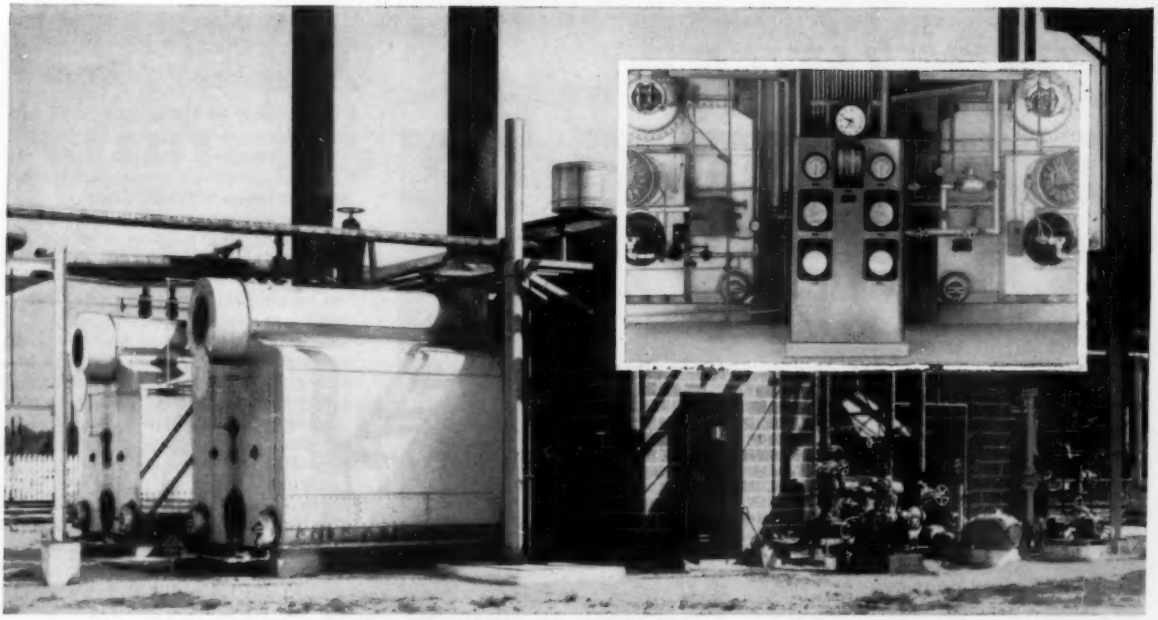



Fig. 3. Detail of hook that engages in lifting hole of manhole cover. Fig. 4 shows details of attachment



# Two Union packaged boilers play important role in Davison cracking catalyst plant

Job Report (UIW) — Proving that they can do their job outdoors as efficiently as indoors, two Union Type MH Steam Generators handle a key assignment for Davison Chemical Company, Division of W. R. Grace & Co. They deliver process steam in Davison's large Lake Charles, La. plant which is equipped to produce approximately 45,000,000 lbs. of petroleum cracking catalysts annually.

Selected for this important role because of "reputation . . . and delivery," these Union Packaged Steam Generators are reported by Davison to be operating at high efficiency.

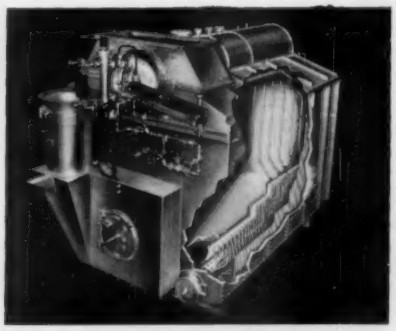
Each of the pair has a steam capacity of 18,000 lbs/hr. at 250 psi and is gas fired. Both were completely assembled in Erie, Pa. by Union Iron Works before delivery to their Louisiana job site.

Patterned after larger but similar field erected Type H Boilers, originated by Union over 16 years ago, numerous MH Packaged Units are being installed in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals.

With standard units designed in 13 sizes from 10,000 to 40,000 lbs/hr. at 250 psi, Union Packaged Steam Generators can be equipped to handle multitudes of needs formerly requiring costly field erection. For example: Superheaters can be installed to meet total temperature requirements, while air heaters and economizers are readily supplied when needed. High pressure units are also available for special applications.

**The complete story of Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.**

**Aerial view of Davison Chemical Company's large Lake Charles, La. plant for manufacture of petroleum cracking catalysts.**



**Cutaway of compact Union Type MH Steam Generator. Tubes arranged for straight-through gas flow with low draft loss.**

**For more data circle 551 on Post Card**

American
ROLLING RING
COAL CRUSHERS
COAL IS SPLIT
-NOT CRUSHED

for More Uniform
COAL
PREPARATION
Proved by Hundreds of Millions of Tons of Reduced Coal.
Coal Crushers up to 800 TPH
Sample Crushers up to 15 TPH
COAL PREPARATION PROBLEM?
Write for Recommendations and Literature.
American
PULVERIZER COMPANY
1431 MACKLIND AVE. • ST. LOUIS 10, MO.
For more data circle 552 on Post Card

## Back-Pressure Turbine

*continued from page 68*

that in view of these estimated savings, the new turbine and low pressure distribution system should be installed. Needless to say, the project was approved without delay.

A power engineering consultant, Kenneth R. Warrington, was retained to check the findings and make detailed plans. Within a year following the appropriation, the new equipment was placed in operation.

The plant extension has now been operating since December, 1954 and it is quite apparent that the savings will exceed the estimate. With a continuing plant growth, even greater use has been made of present facilities. The low pressure steam piping system which was made available provided a different approach to certain design problems. This can be illustrated by the following case:

There were approximately 1,000 tons of refrigeration and air conditioning equipment throughout the plant. The installation of additional air conditioning equipment of 160 tons capacity in a localized area would ordinarily have been a mechanical job. With the low pressure steam line available, having the added advantage of summer steam demand, the economics of the situation clearly indicated low pressure steam jet equipment for providing chilled water.

Experience with this expansion of power facilities has been a favorable one in all respects. The change of steam supply to various pieces of equipment during the winter months was accomplished without difficulty.

The savings incurred in this power installation are ample proof that the power engineer's responsibilities include more than the efficient operation of present equipment. He must be ever watchful for opportunities to effect real savings. It may be a chance to utilize a less expensive fuel or it may be a major equipment installation such as the one just described. But management relies on its power engineers to recognize and take appropriate steps toward increased efficiency and lower operating costs. It is in such ways that the prestige of the power engineering profession is enhanced.

**WOULD YOU LIKE TEAR SHEETS?**

Readers wanting tear sheets of any article appearing in the issue for their personal file may obtain them by indicating the item desired on one of the post cards appearing in this issue—Editors.

# Announcing ...DIAMOND "Multi-Port" Bi-Color Gauge

## for BOILER PRESSURES to 900 psig

MODEL MP-900

Ports Have Individual Round Glass, Mica and Gasket Instead of Long Strips
"Sealed Beam" Lamps in "Hi-Lite" Illuminator
STEAM SHOWS RED
WATER SHOWS GREEN
Complete Port Change and Cut Back into Service in Minutes Instead of Hours
Gauge Not Removed from Boiler for Gasket Changes and Other Normal Maintenance
End Stems Stainless Steel (Also Available with Flange Connections)

The individual round ports each having its own round glass, round mica and round gasket (instead of the conventional long strips) means less stress and strain . . . resulting in greatly reduced maintenance. When replacement is required, it is usually only one port . . . which can be changed in a very few minutes . . . and without removing the gauge from the boiler.

**The Diamond Bi-Color feature is another important advantage of the MP-900 Multi-Port . . . steam always shows red and water always shows green. There can be no question of the water level.**

Recommended for both new and old boilers up to 900 psig, the MP-900 Multi-Port will give you a new standard of gauge operation. Use the coupon below for additional information.

7358

DIAMOND POWER SPECIALTY CORP. AB
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 2044 explaining the advantages of the Diamond MP-900 "MULTI-PORT" Bi-Color Gauge for all boiler operating pressures up to 900 psig.

NAME_____

COMPANY_____

ADDRESS_____

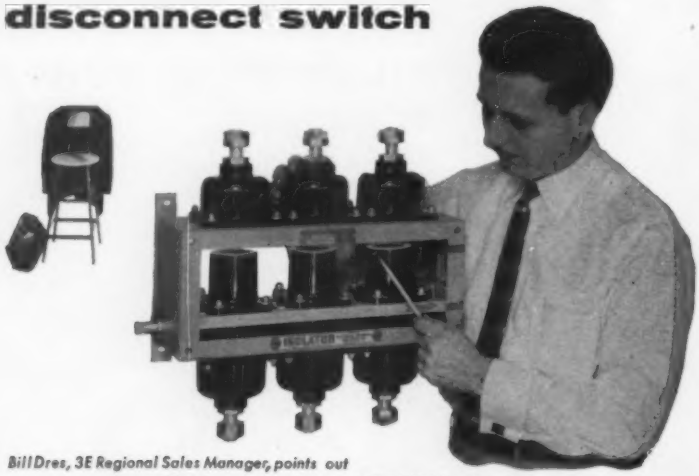
**DIAMOND POWER SPECIALTY CORP.**

LANCASTER, OHIO

*Diamond Specialty Limited • Windsor, Ontario*

**For more data circle 553 on Post Card**

## Straight line action makes ISOLATOR the most efficient disconnect switch



*Bill Dres, 3E Regional Sales Manager, points out the visible air gap—an important ISOLATOR safety feature*

**ISOLATORS save on cubicle construction and floor space** because they take about ⅓ the space required by equally rated knife switches. They also weigh less and as all elements, including poles, are mounted and aligned on a rigid frame at 3E, they are simple to install. When the ISOLATOR moves from closed to open position its current carrying parts move in a straight line and telescope as contact is made. The parts are enclosed in insulated bushings which also telescope, shielding live parts and eliminating flash barriers.

**ISOLATORS are safer** . . . in the open position, the gap between the bushings is easily visible. Yet the opening is narrow enough to lessen the chance of accidental contact with the live parts. The exposed studs at top and bottom are arranged for easy taping. When your men work in cubicles equipped with ISOLATORS they will be safe from live part hazards.

**This switching center,** designed and built entirely by 3E, shows how ISOLATORS make a compact, functional and handsome unit. These are 5 KV, 200 ampere ISOLATORS. The ISOLATOR is also ideal in combination with potheads; any number of arrangements are possible and the units are easily interchanged if necessary. 3E makes many kinds of indoor and outdoor switches, and has a staff of engineers experienced in designing complete units for all types of special applications.

***On your next switching problem, See 3E for recommendations and estimates.***

**ELECTRICAL ENGINEERS EQUIPMENT CO. Melrose Park, Illinois**

**For more data circle 554 on Post Card**


## Thermonuclear Power

*continued from page 85*

to the solution of the thermonuclear problem than we are today.

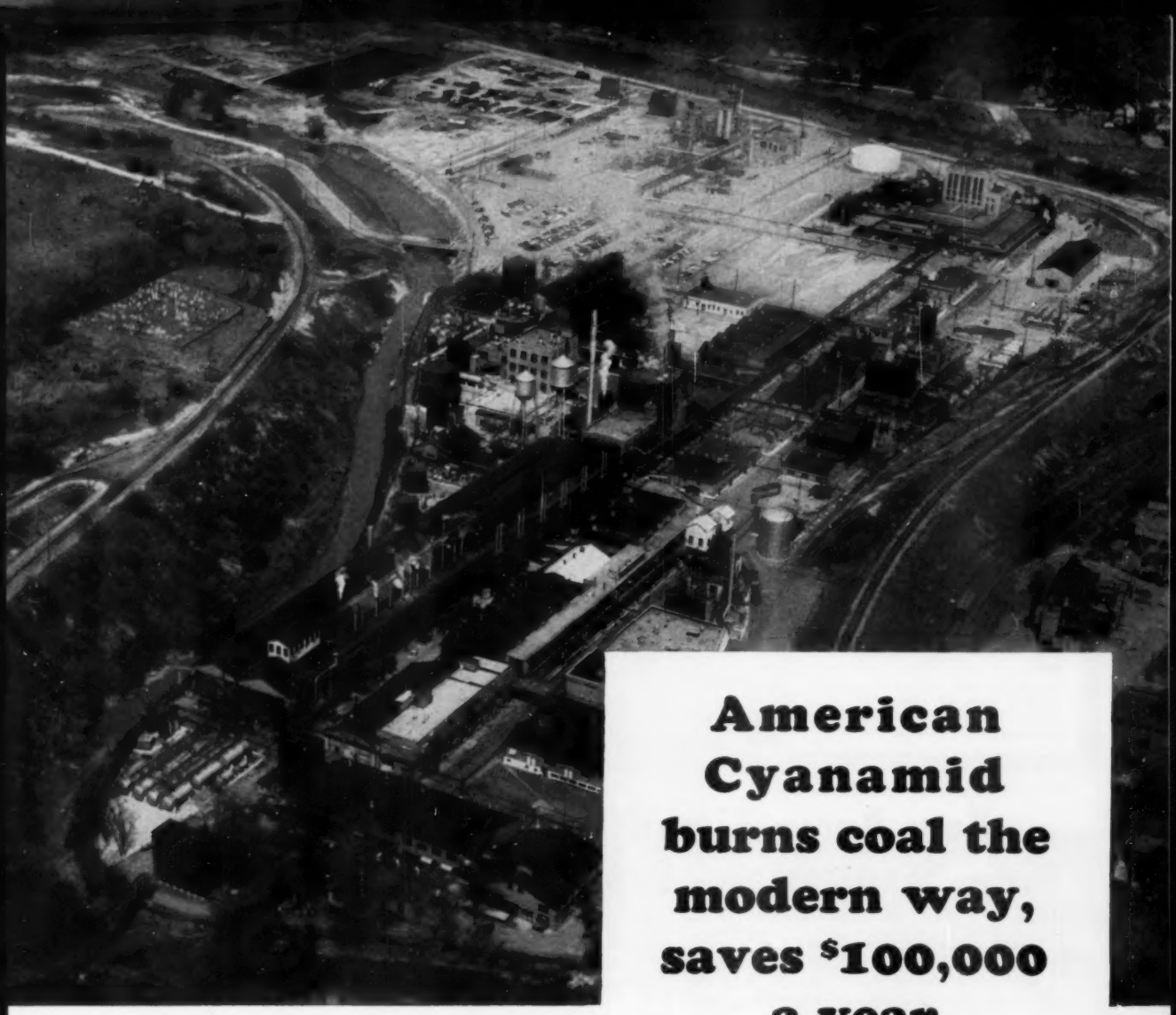
Aside from their value in the study of nuclear forces high energy accelerators may have practical application in controlled thermonuclear processes. Last summer at Geneva, Dr. Bhabha indicated that if accelerator development concentrated on higher current, rather than higher energies, it might be possible to produce appreciable amounts of thermal energy capable of starting off a fusion reaction. At present the currents developed by all accelerators are measured in microamperes. Dr. Bhabha felt that if we concentrated on high current accelerators we might get as much as several amperes, and such currents might be able to produce temperatures sufficiently high to initiate a fusion reaction.

While it is true that all nuclear reactions known thus far have been produced by bombarding targets with accelerated particles, the chances of setting off a fusion reaction with conventional accelerators is extremely remote. Dr. Hans Thirring discussed this subject before the National Industrial Conference Board last October and showed that cross section of the particles is so small and the distances between the nuclei in the target so vast compared to the size of the particles that perhaps less than 0.0001 per cent of the bombarding particles would be able to initiate reactions. Thus, even though the output per process might be 100 times the input, the business as a whole would end with a loss because of the enormous percentage of wasted nuclear projectiles. This fact, of course, was indicated in the original Cockcroft-Walton experiment.

It is clear then that there is no easy way out of the difficulties and it may be that some approach as yet unformulated may be required in order to achieve success.

As mentioned at the beginning of this article, the research on controlled thermonuclear processes is being carried on under Project Sherwood of the AEC at three different places, Los Alamos and Livermore Laboratories, and at Princeton University. These are all classified projects. There are, however, two unclassified thermonuclear research projects under way, one at the University of California and the other at Tufts University in Massachusetts. Despite the AEC's efforts to keep thermonuclear research secret the broad outlines of the technical problems are becoming clear, and these "open" laboratories are working with high intensity magnetic fields and methods of creating very high temperatures, both of which are of fundamental importance in thermonuclear research.

As reported in *Nucleonics*, at the



# American Cyanamid burns coal the modern way, saves $100,000 a year

## Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

## *facts* you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Increased production demanded additional steam in American Cyanamid's plant at Bridgeville, Pa. Management decided to analyze its power system with an eye to improving operating economy and efficiency.

The decision was *modernization,* with emphasis on more efficient distribution of steam, generated by burning pulverized coal. New steam traps were installed, waste steam was utilized, condensate was recovered, piping was simplified, a thorough system of maintenance and repair was instituted. The sound thinking behind this unusual program—unusual in that power system economies took place *after* steam generation—today rewards American Cyanamid with a savings of $100,000 a year!

*For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.*

NATIONAL COAL ASSOCIATION
Southern Building • Washington 5, D. C.

For more data circle 555 on Post Card

FLEXIBLE **BARCO** BALL JOINTS

**NO MAINTENANCE IN 23 YEARS!** The arrows point to Barco Ball Joints on two steam lines in a tunnel. At the time of the photograph, two of the joints had been installed twenty-three years without service.

# How Barco Simplifies Pipe "Expansion" Problems

**1. Many new applications!** Every day, interesting new uses are being discovered for Barco Flexible Ball Joints in relieving *expansion* and *contraction* in piping — in Power Plants, Steel Mills, Ships, Petroleum and Chemical Processing Plants, and in Central Heating Systems.

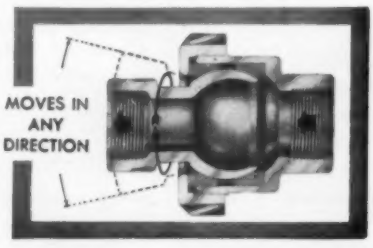
**2. Tested and proved in service!** Thousands of Barco Joints are now installed in steam and condensate piping. Users report complete satisfaction.

**3. No heavy "pipe anchoring" required.** Barco Flexible Ball Joints do not develop "end thrust" under pressure—no special provisions are necessary to tie down pipe or joints. Also, they eliminate angular strain.

**4. Complete flexibility.** Barco Joints do not need to be aligned for straight linear expansion—they handle lines at angles and with perpendicular take-offs with equal ease.

**5. Save space! Cut costs!** For installation information, ask for a copy of Engineering Drawing No. 10-50165 and new Barco Catalog No. 215B. Joints are available in a wide range of sizes; angle or straight, threaded, flange, or welding ends.

**BARCO**
*Manufacturing Co.*
547G HOUGH STREET
BARRINGTON, ILLINOIS




For more data circle 536 on Post Card

## Thermonuclear Power

*continued from page 108*

University of California, Professor Vollrath has been able to achieve pulsed currents of 5000 amp in hydrogen at 1 mm pressure. At these high currents the self-magnetic field of the current exerts a force to pinch the current stream into smaller diameters. Vollrath observes the beginnings of the pinch effect in his apparatus but the gas temperatures (i.e. ion energies) involved are still far too low to hope to observe any fusion reactions.

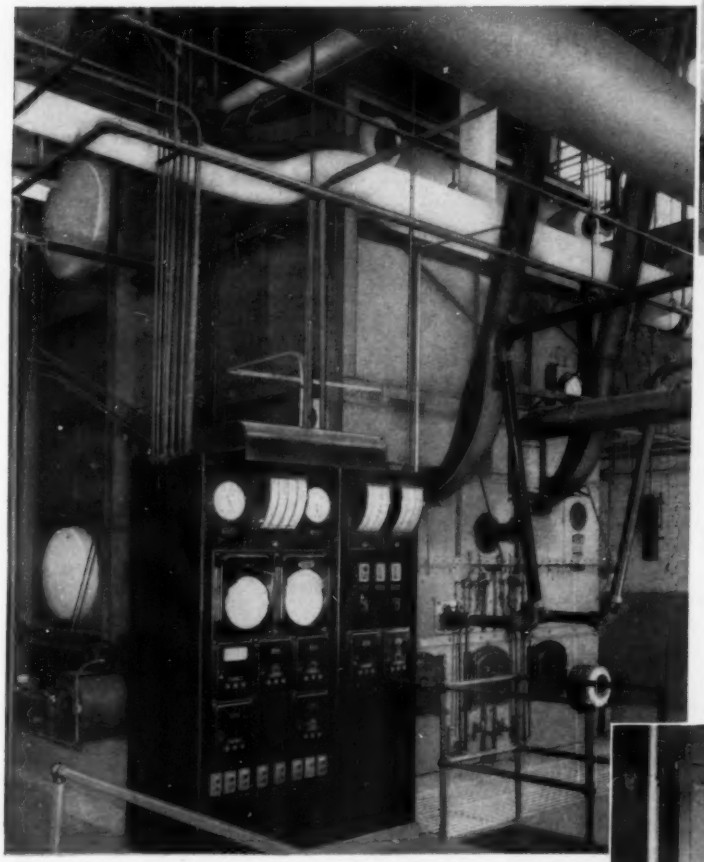
At Tufts, work is also being carried on in the field of high current phenomena and in tubes containing gases at low pressures and under the influence of high intensity magnetic fields currents of 8000 amp have been attained. The highest temperatures so far reached are in the region of 250,000 K. Such temperatures, however, correspond to ion energies of only 25 electron volts, obviously far too low to be of any value in fusion processes.

In its conclusions concerning this question of thermonuclear power the McKinney Report stresses its great importance. It is truly a frontier research project. It concerns a basic energy resource which could have a tremendous impact on the economics of the entire world, and the Government has a clear obligation to give it full support as well as to stimulate scientific contributions from every quarter. At the same time there is also an obligation to the public and to those being encouraged by the Federal Government to invest in nuclear fission power to see to it that they are allowed to have an adequate foundation upon which to base a determination for themselves of the propriety of their investments and their actions.

---

"What's this bill for an automobile spotlight and rear view mirror mean . . . ?!"

# KEELER TYPE M-K STEAM GENERATOR SERVES G-E CABINET PLANT

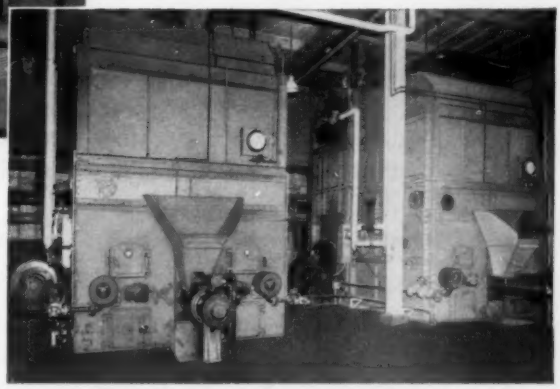


General Electric Company
Illinois Cabinet Works
Rockford, Illinois

**KEELER**

**TYPE M-K**

All purpose cross drum water tube type steam generators provide high efficiency with any method of firing—for coal, oil, gas or waste fuel operation (or combinations), with ready convertibility.



In modernizing the power plant of its Illinois Cabinet Works, the General Electric Company selected the Keeler Type M-K Steam Generator pictured above to supply low cost steam for its process and heat requirements.

The unit has a rated capacity of 35,000-lbs. of steam per hour and a 200 psi design pressure. This is a coal fired operation, of the automatic over-fired, spreader type with provision for conversion. The complete Keeler installation includes all burning equipment, controls. safety devices and accessories.

Keeler Type M-K Steam Generators provide the efficiency of bent tube construction with fast water circulation. A Keeler modernization of old and proven techniques, they feature a compact design that prevents excessive radiation losses with water cooled, completely steel encased and insulated furnace walls and roof.

The Type M-K is made in capacities from 12,000 to 150,000-lbs. of steam per hour with a standard design pressure of 160 psi, a maximum design pressure of 500 psi and a total maximum steam temperature of 750° F. These generators can be operated at high ratings and high efficiency with any firing method, for burning coal, oil, gas, waste fuel as well as combinations, and include provision for ready convertibility.

The list of Keeler Type M-K installations reads like "Who's Who of American Business and Industry" . . . including aircraft, automotive and chemical plants, universities, hospitals and central heating plants. The two unit photo immediately above shows a recent installation in a large mid-western college.

Write or phone for complete information . . . there's a Keeler representative at your service in your locality.

*The Seal of Quality in Water Tube Boilers*

**Write For Bulletins**

**No. MK-1: Type MK Boilers**
**No. DK-1: Type DK Package Boilers**
**No. F-14: Type CP Package Boilers**
**No. M-2A: Type CPM Package Boilers**

**KEELER** WATER TUBE *Boilers*

— ESTABLISHED 1864 —

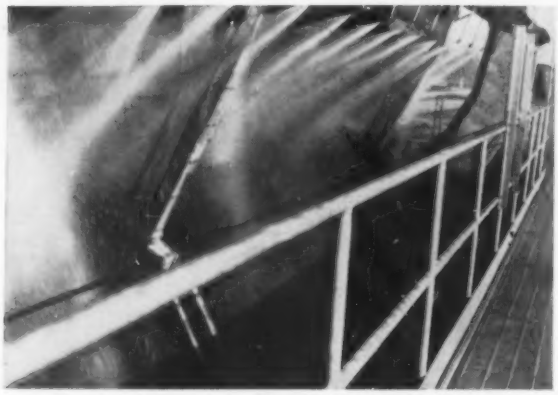
**E. KEELER CO.**

**100–200 West St. • WILLIAMSPORT, PA.**

— OFFICES IN PRINCIPAL CITIES —

**For more data circle 557 on Post Card**

# Handling 12,000 Tons of Coal Daily with NO DUST



Close-up of J-M system in action at car dumper

## Giant Power Plant controls dust at...

- **Rotary Car Dumper and Shakeout**
- **Barge Unloader**
- **Crusher Area**
- **Conveyor Transfer Points**

J-M dust control equipment was installed because of its high effectiveness and unusual flexibility of application. This is only one of many examples of how a Johnson-March system effectively solves dust problems for power stations and industrial plants.

## J-M Dust Control costs only 1/10 as much!

No costly ducts, hoods, or fans. Almost no maintenance. An economical Johnson-March system can eliminate fire and explosion hazards, community dust nuisance, safety hazards, and maintenance problems. Even the efficiency of existing mechanical dust collectors can be improved by the addition of a J-M liquid system at low cost. Call or write — for an obligation free analysis of your problem of controlling dust, fumes or odors.

**Johnson March**

*Dust Control Engineers*

**1724 CHESTNUT ST., PHILADELPHIA 3, PA.**

**CANADIAN REPRESENTATIVES: G. F. Sterne and Sons, Ltd., Brantford, Ontario**

**For more data circle 558 on Post Card**


## Burlington's New Unit

*continued from page 89*

under the ridge of this pile permit reclaiming approximately 4500 tons of coal.

The coal is automatically conveyed by Hewitt-Robins conveyors from the 4500-ton active pile to Stephens-Adamson Redler conveyors loading any or all of five 50-ton silos, each of which feeds one coal pulverizer, as shown in Fig. 4. Complete details of this coal handling system will be given by the Public Service engineers in a future paper.

The ash and dust systems are separate. The A-S-H dust system is arranged so that dust can be refined in the furnaces or sluiced by jetting to the disposal area. Research Corp. combined mechanical-electrical equipment collects the dust. Facilities have also been provided for sale of dry bulk dust.

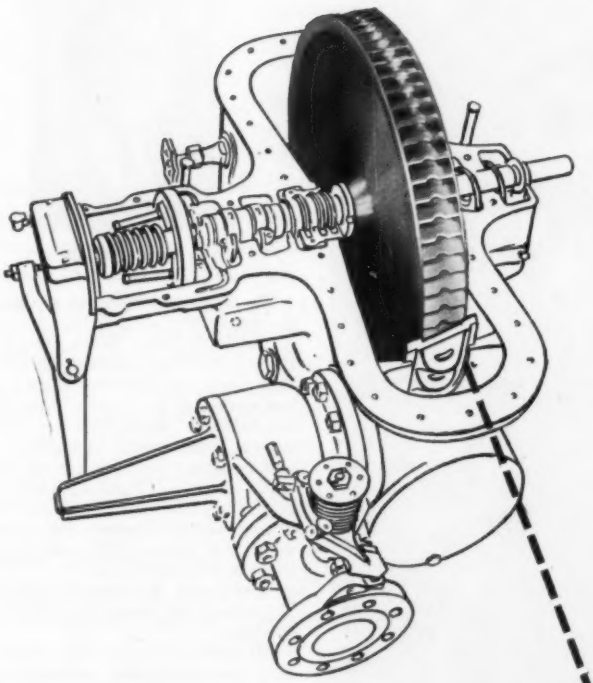
The United Conveyors ash system includes facilities for jetting the slag to the disposal area or through a dewatering bin, for sale. Pyrites at the pulverizers are disposed of by separate sluicing to the dust disposal area so as not to contaminate the slag, which is marketable.

Main generator has hydrogen cooled rotor and stator and is rated at 205,882 kva or 175,000 kw at 85 per cent power factor with 30 psig hydrogen pressure. Main generator leads consist of Okonite's Oilostatic pipe type cable in four 8⅝-in. O.D. three-phase pipes, 6000 amp total, 23 kv. Two main power transformers are Westinghouse 130,000-kva each, 3-phase, 138 grd Y-13 kv., while an auxiliary transformer is an Allis-Chalmers 9000-kva unit.

Emergency rating of one main transformer permits it to carry 75 per cent of the generator output if the other is out of service. Westinghouse lightning arresters are used. Auxiliary power switchgear is by ITE and Westinghouse and an ITE isolated phase bus leads from the auxiliary generator while a metal-enclosed, non-segregated phase bus leads from the auxiliary transformer.

"If my memory serves me sir, we posted that form back in January 1953."

# Work Horse of Industry..since 1906



TERRY

The Terry Steam Turbine Company was incorporated in 1906 to manufacture *a workable and efficient prime mover that would operate with minimum maintenance.* This prime mover was the solid-wheel turbine, which had been invented by Edward Clinton Terry a few years before.

Although maintenance practice has improved vastly since then, the demand for the turbine has multiplied many times. *Rising maintenance costs have actually increased the need for trouble-free operation.*

Today, there are more Terry solid-wheel turbines in operation, and there are more built each year, than ever before. The explanation is simple.

Here is a turbine with a virtually indestructible wheel. Made of a single forging of special composition steel, there are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which may occur does not materially affect horsepower or efficiency.

Blades will not foul. They have large clearances and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

These are a few of the reasons why the Terry solid wheel turbine has been the *work horse of industry — since 1906.* For the full story, send for a copy of Bulletin S-116.

**THE TERRY STEAM TURBINE COMPANY**
**TERRY SQUARE, HARTFORD 1, CONN.**

**1906** was the year this turbine was built in Terry's plant. It is believed to be one of the first small direct-connected turbines built for commercial use in the United States.

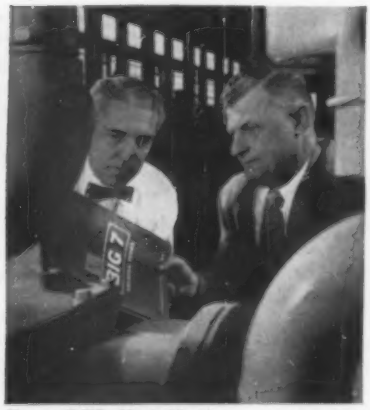
IT-1203

For more data circle 559 on Post Card

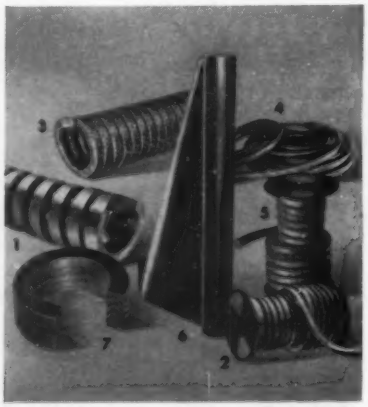
## R/M's Big 7 Packing Types give you dependable custom-built performance

**When you standardize on R/M's Big 7,** you are sure of getting superlative, custom-built performance that will greatly reduce your maintenance costs and downtime. You can set up a schedule of preventive rather than corrective maintenance. Most plants require only 3 or 4 types.

**R/M's "Teflon"* packings,** Type 5, for example, are unsurpassed for use on chemical pumps and valve stems. Carefully engineered and custom-built for their applications, they are lasting longer in service and lengthening the life of the equipment they are used on.



**Your R/M distributor** will be glad to explain how you can profit by standardizing on the Big 7. Besides reducing costs and downtime, the Big 7 will lower inventories, simplify ordering. R/M packings for maintenance are sold only through authorized R/M distributors.




**Type 1,** for pumps, valves; **Type 2,** for high temperature valve stems, expansion joints; **Type 3,** for high speed rotary air compressors; **Type 4,** for corrosives, acids, viscous materials; **Type 5,** "Teflon" for chemicals; **Type 6,** gasket materials; **Type 7,** for hydraulic and pneumatic equipment.

*Du Pont trademark

R/M'S BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M **BIG 7 PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Crawfordsville, Ind.; Neenah, Wis.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Laundry Pads and Covers • Bowling Balls

For more data circle 560 on Post Card


# OBITUARIES

## Ollison Craig

OLLISON CRAIG, Vice President of Riley Stoker Corp., died recently in Holy Cross Hospital at Ft. Lauderdale, Florida where he was vacationing. He was 68.

Ollison Craig

He was prominent in national engineering circles and had been associated with Riley Stoker Corp. since 1920. He became associated with Riley as a research engineer and was instrumental in the development of combustion equipment. He was named engineering manager in 1937 and became vice president in 1949.

A native of Sullivan, Ill., he received his bachelor of arts and master of engineering degrees from the University of Illinois. He held professorships in engineering at the University of Colorado, Vanderbilt University, University of Texas and Iowa State College.

He was a fellow of ASME and was awarded the society's special 75th anniversary medal May 12, 1955. He was made a fellow of the society in 1946.

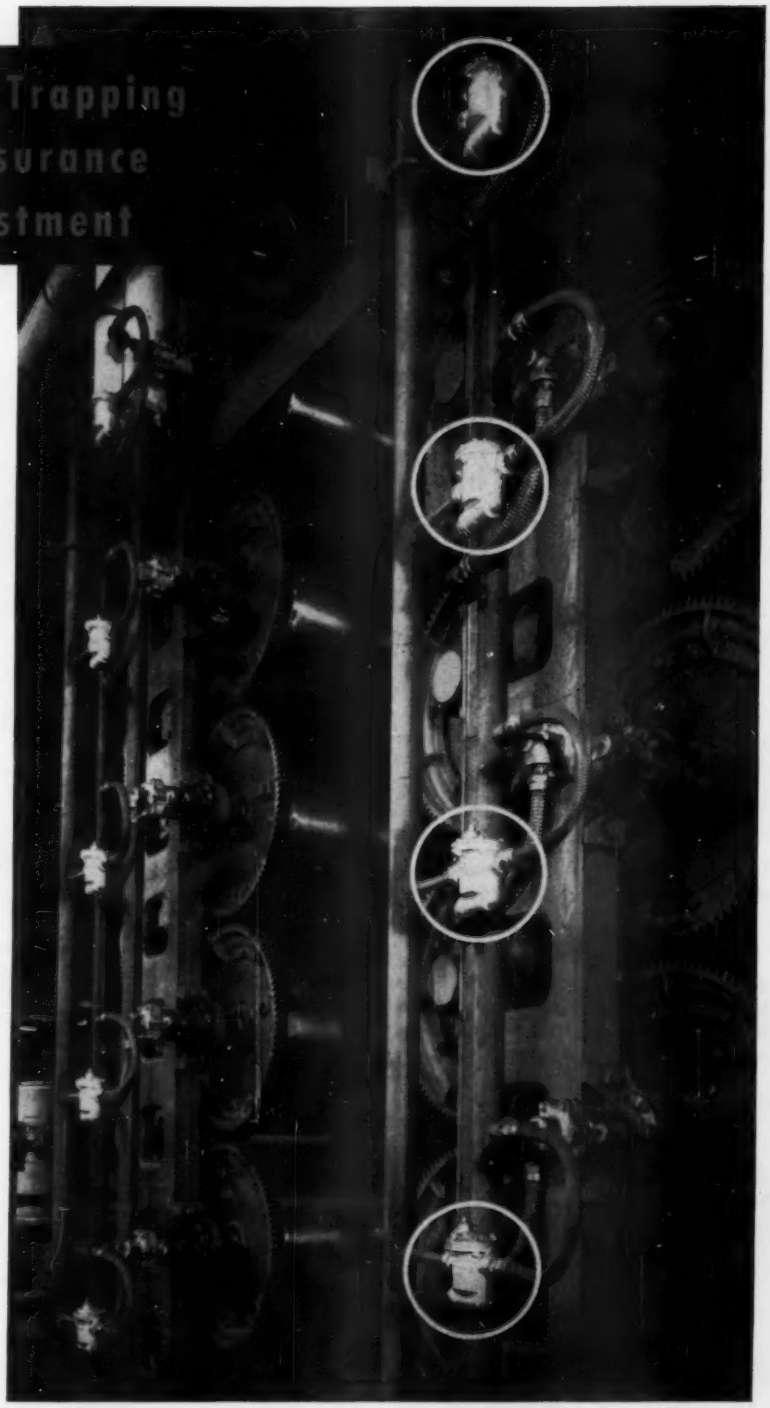
He was a 32nd degree Mason and was a member of Morning Star Lodge, Ancient, Free and Accepted Masons of Worcester, and a member of Aleppo Temple, Knights Templar, Boston.

# NEW ENGINEERING BOOKS

**Bibliography and Abstracts on Electrical Contacts.** ASTM Special Technical Publication No. 56-H; 80 pages; heavy paper cover; 6 by 9 in. Price $1.00. The 225-page 1952 book is available in paper cover at $5.50. Copies can be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

In 1952, the American Society for Testing

# Armstrong Unit Trapping —Low Cost Insurance of a Big Investment



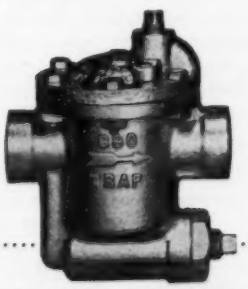
● *30% more production from kettles . . . 84 degrees higher dryer temperatures . . . 8% more output from dry kiln*—these are typical results of unit trapping with Armstrongs.

What about your plant? It doesn't make good business sense to spend $500, $5000 or $50,000 for equipment and then lose 10% to 30% or more of its productivity for lack of proper trapping.

Armstrong traps are "application engineered" by men who know trapping thoroughly—how to size traps for fast heat-up and top temperatures . . . correct installation practice . . . steam supply and return line requirements . . . variable pressure problems . . . mysterious difficulties. The cost of retrapping with Armstrongs is usually but a fraction of 1% of the cost of the equipment drained—*low cost insurance of a big investment!*

Call your Armstrong Representative today. He sells on a basis of "satisfaction or your money back." Or, write:

**ARMSTRONG MACHINE WORKS**
**810 Maple St., Three Rivers, Mich.**




**Armstrong built-in strainer traps, pictured on textile dry cans at the right, cost less to buy and install than standard traps and separate strainers—they reduce maintenance and costly shutdowns. Three sizes, ½" or ¾" connections.**

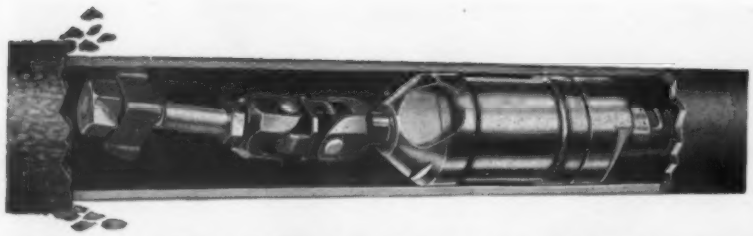
**SEND FOR FREE STEAM TRAP BOOK . . .**

**. . . 44 pages of how-to-do-it data. Useful and educational. Free on request without obligation.**

S45

# ARMSTRONG STEAM TRAPS

**For more data circle 561 on Post Card**



# ROTOJET®

## Cleans Fire Tubes ▸▸▸▸▸▸ FAST ▸▸▸▸▸▸▸

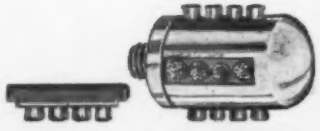
**INSIDE** *and* **OUTSIDE**

**You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.**

**Try the new Rotojet, and no other tube cleaner will ever satisfy you.**

### Economical Roto Brushes

**Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.**



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.

Model S52S ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model S50S ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

**ELLIOTT COMPANY-ROTO DIVISION**

**147 Sussex Avenue, Newark 1, N. J.**

**For more data circle 562 on Post Card**


## Engineering Books

*continued from page 114*

Materials republished their Bibliography and Abstracts on Electrical Contacts. The original printing of January 1944, and all the supplements that have been issued since then were included, many duplications were eliminated and errors corrected.

Thus the new supplements which have just been published become the first for the 1952 edition, and it includes all new references collected up to January 1, 1954.

★ ★ ★

**Perceptualistic Theory of Knowledge,** by Peter Fireman, first edition, 50 pages, 5¾ by 8 in.; cloth. Published by the Philosophical Library, 15 E. 40th St., New York 16, N. Y., 1954. Price $2.75.

This little book deals largely with an analysis of our thinking processes and our perception of objects and events. As the author points out, feelings of pain and pleasure are the utmost preoccupations of our life. Clear consciousness of these feelings is a prerequisite of our living.

It is to a discussion of these ideas that this book is devoted. The discussion is not simple, however. It takes the reader into the vague and shadowy no-man's land which lies between logic and mathematics where much of what has been said even by the experts is subject to argument and beset with questions of semantics. Nevertheless, for the serious thinker, for those who wonder what consciousness is, what perception is, and how consciousness and perception are related to what we call "thinking", this book should have considerable appeal.

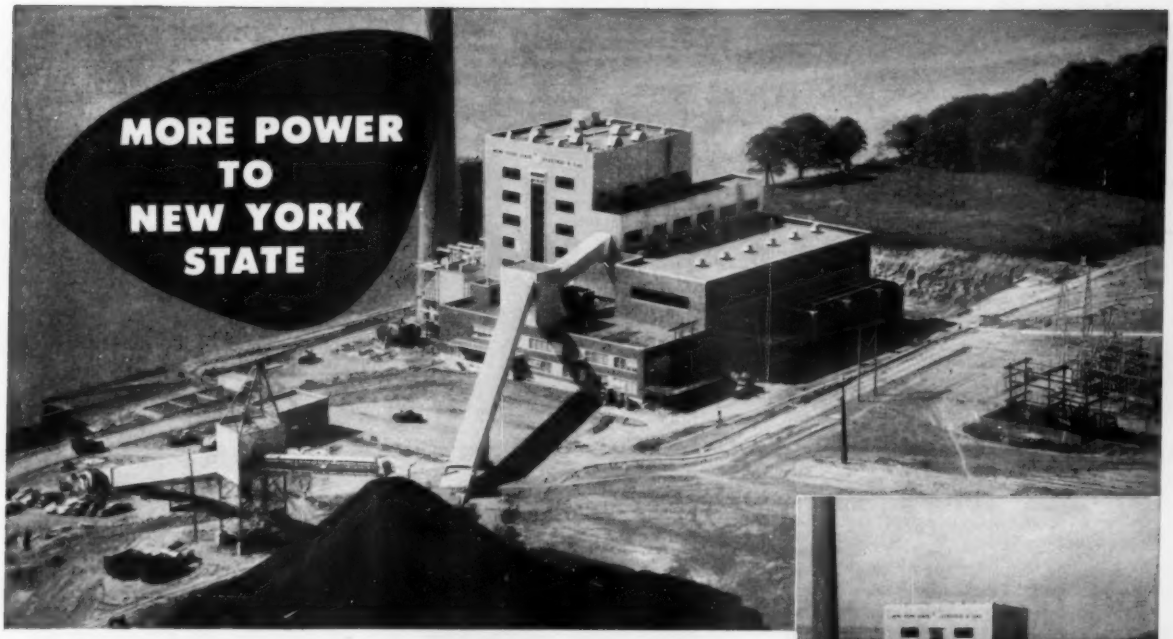
The contents are divided into five major divisions, as follows: 1. Perception; 2. Thinking; 3. Logic; 4. Synthetic Mode of Thinking; 5. Analytic Mode of Thinking.

★ ★ ★

**Steel Structures Painting Manual, Vol. 2 — Systems and Specifications,** Joseph Bigos, Editor. Size 8½ by 11¼ in., 292 pages; cloth. Published by Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh 13, Penna. Price $6.00.

This is the second of two volumes that cover in great detail every aspect of painting steel structures. Volume 1 described the best of the current surface preparation and painting practices in various industries; this volume, released after four years of preparation, contains very specific recommendations on painting a tremendous variety of steel structures and surfaces in various exposures. Complete guides and indexes make it easy for engineers, architects, fabricators, and maintenance supervisors to quickly, easily, and correctly specify complete paint jobs for new work or maintenance painting.

This volume differs in this respect from Volume 1 — "Good Painting Practice" — since the latter is an encyclopedia of comprehensive and detailed information on all




# S-A COAL CONVEYOR SYSTEM

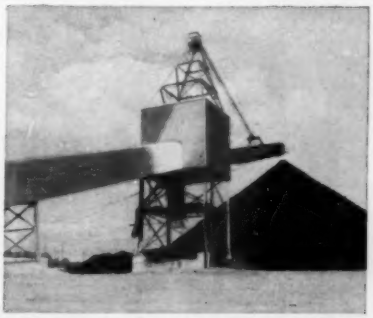
## IS PART OF A NEW APPROACH TO *Kilowatt Economy!*

The power industry will watch with interest, the operation of the New York State Electric and Gas Corporation's giant new Milliken Generating Station at Cayuga Lake, New York.

An active outdoor storage pile with continuous and automatic reclaiming replaces large indoor bunkers in the STEPHENS-ADAMSON engineered coal handling system designed and built for this customer in collaboration with their engineers and consultants, Gilbert Associates, Incorporated. A 900 ton per hour conveyor handles the fuel from car dumper to active storage. Two 300 ton per hour belts convey the coal from the active storage to the small plant bunkers. Continuous flow from outside storage to bunkers is electronically controlled to maintain constant bunker level. The entire coal handling system is operated by only three men.

S-A experience in building conveyor systems for the power field may well be one of the keys to success in this venture in economical coal handling at Milliken Station.

S-A double belt conveyor leads from yard storage pile to station transfer point, thence to direct discharge into coal bunkers. Vibratory feeders beneath pile supply crushed coal to electronically controlled belts.



Coal is belt conveyed from car dump hoppers containing two apron feeders to this hinged boom station. Boom discharges to yard storage pile. These facilities are manually operated on intermittent schedule.

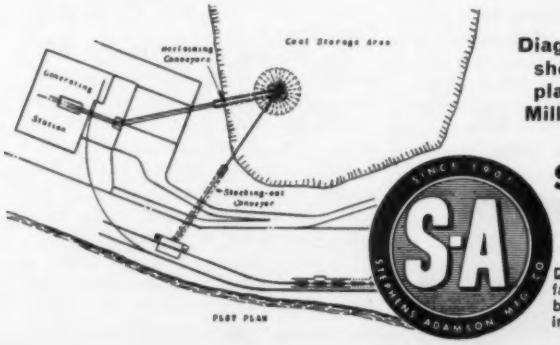



**Diagram drawing shows overall plan layout of Milliken station.**

## STEPHENS-ADAMSON MFG. CO.

**86 Ridgeway Ave., Aurora, Ill.—Los Angeles, Calif.—Belleville, Ontario.**

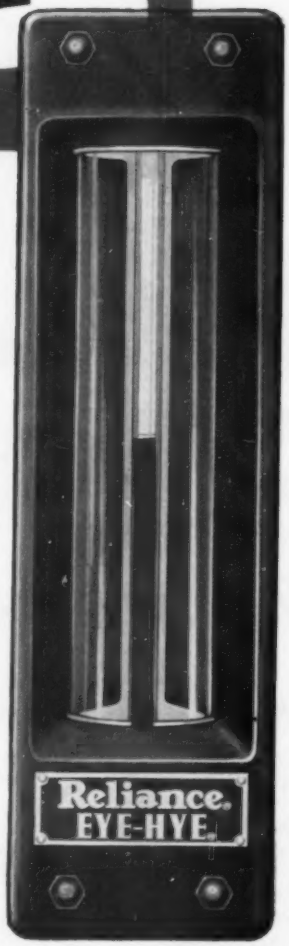
**ENGINEERING DIVISION**
Designers and manufacturers of all types of bulk materials conveying systems.

**STANDARD PRODUCTS DIVISION**
A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

**SEALMASTER DIVISION**
A full line of industrial ball bearing units available in both standard and special housings.

**For more data circle 563 on Post Card**

Newly Styled—
Wide Vision, Simplified Face
EYE-HYE®

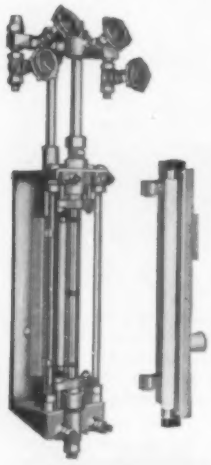



## The Reliance Remote Reading Water Level Indicator

**Accurate "liquid column" reading visible from large area because of brilliantly illuminated green liquid and wide angle face plate.**

EYE-HYE is the original trouble-free manometric gage for dependable remote water level supervision. There's nothing new about its *operation*, but the new face plate and new illumination (fluorescent) make it easier to read all over the control room.

*Simplicity* is the secret of EYE-HYE's dependable full-range accuracy — no mechanical working parts — no adjustments on location. Supplementary alarms — lights or horns — can be added by equipping EYE-HYE with Reliance EA9-R Levalarm. Models for any remote gage need — any pressure. Write for Bulletin CO.



### Fluorescent Illumination

Even lighting the entire length of the gage window is provided by a fluorescent tube. The fluorescent unit is available separately for installation in all but very old EYE-HYE models in use. Write for prices; mention the model number found on name plate.

**THE RELIANCE GAUGE COLUMN CO.**
5902 Carnegie Avenue, Cleveland 3, Ohio

For more data circle 564 on Post Card

## Engineering Books

*continued from page 116*

phases of cleaning and painting steel structures. In addition to guides and indexes of recommended painting schemes, Volume 2 includes complete specifications for surface preparation, pretreatment, paint application, paints, and paint systems. Now, it is possible to specify the painting of a steel structure in the same easy, precise method as the steel itself is specified — by reference to a specification number.

The new volume, called "Systems and Specifications", has been prepared with the assistance of several hundred technical consultants and edited by Dr. Joseph Bigos, Senior Fellow of Mellon Institute, and Director of Research of the Steel Structures Painting Council.

Steel Structures Painting Council is an impartial, nonprofit organization supported by voluntary contributions from organizations concerned with the manufacture, specification, or use of paints or other coatings for the protection of steel surfaces. It was organized in 1950 through the efforts of the American Institute of Steel Construction.

★ ★ ★

**Metallizing: Part IC — Application of Metallized Coatings to Protect Against Heat Corrosion** by AWS Committee on Metallizing. Size 6 by 9 in., 9 pages; paper. Published by the American Welding Society, 33 W. 39th St., New York 18, N. Y. Price 50¢.

This booklet, published by the American Welding Society, provides an authoritative source of information concerning metallizing for protection against heat corrosion for temperatures up to and over 1800 F.

Equipment requirements and methods of surface preparation are listed in detail. The metallizing procedure, including wire and sealer compositions and inspection tests, are also given as well as typical coatings for specific applications.

★ ★ ★

**Steel Structures Painting Manual,** Vol. 1 — Good Painting Practice, Joseph Bigos, Editor. Size 8½ by 11¼ in., 423 pages; cloth. Published by Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh 13, Penna. Price $6.00.

This extremely comprehensive book describes the best of the current surface preparation and painting practices in various industries. It is written from the point of view of the paint user and is not intended to be a scientific or highly technical treatise. Each chapter is written by an expert in his own field, and the chapter titles which follow give a good idea of the scope of the book.

Chapter titles are: Simplified theory of corrosion; mechanical surface preparation; chemical surface preparation; practical aspects, use, and application of paints; inspection; quality control of paints; comparative

# Hall Industrial Water Report

VOLUME 4 JUNE 1956 NUMBER 3

## Slime—a Low Life That Rates High as the Cause of Corrosion, Deposit Formation, and Offensive Odors

Control of slime in cooling and process water depends on proper diagnosis of the problem and use of effective disinfectants.

### A Difficult Odor Problem

Every Monday morning when the air conditioning system was started following Sunday shutdown, one of Pittsburgh's largest department stores was embarrassed by a strong musty odor. This usually disappeared before the store opened at noon, but when the dehumidifiers were shut down several days for repair, the odor was so distressing and persistent that Hall Laboratories was called on for help.

Hall engineer, R. A. Danesi, recognized that aerobic microorganisms washed from the air filters into the spray unit pans were responsible for the odor. When units were shut down, there was insufficient aeration to keep the microorganisms alive and they died and rotted.

Danesi immediately fed an odorless disinfectant to the pans. The obnoxious odor did not disappear fast enough, however, and it was necessary to use a strong oxidizing agent as a temporary measure.

A sample of the slime was brought to the laboratory for identification. The report confirmed the presence of protozoa and bacteria which continue to live and multiply so long as they receive an adequate supply of air. Since equipment shutdowns could not be avoided, control would have to be accomplished by effective disinfection to prevent accumulation of slime.

Feeding of Calgon Algaecide® and regular water washing of the units eliminated the odor for a time. When the odor returned, another disinfectant was fed. This also worked for a time. But these were tough little bugs which built up immunity to either material when it was used continuously.

Alternate feeding of the two chemicals every two weeks proved to be too much for them, however. This procedure solved the problem and the store now has odorless operation of the treated units.

### Labor Costs Effectively Reduced

Fouling of the evaporative condensers used to cool ammonia for process refrigeration was so severe in a rubber manufacturing plant serviced by Hall's Boston office that the units had to be hand-cleaned every week end to insure continuity of operation through the following week.

Investigation revealed that slime was retarding heat transfer. This condition was aggravated because the slime also trapped air-borne talc to such an extent that deposits completely filled the spaces between some of the condenser tubes. Head pressure on the ammonia compressors was continuously at its upper limit and was high enough at times to shut them off.

Treatment was started with 50 ppm of calcium hypochlorite to kill the growth and the sytem was flushed to get rid of the dead slime-forming organisms. Thereafter, calcium hypochlorite was added in sufficient amount every shift to give 1 ppm residual chlorine one hour after treatment. 5 to 10 ppm of Calgon T® was also added continuously to the water for control of corrosion.

Head pressure on the ammonia compressors shortly decreased to 50 psi below the former high, reflecting improved heat transfer in the evaporative condensers. Manual week end cleaning of the condensers is no longer required. Regular operators are able to take care of feeding chemicals so that there has been no increase in labor cost.

### Formaldehyde to the Rescue

A Michigan laboratory engaged in the manufacture of pharmaceuticals, culture media, and related items had a very complicated problem of slime growth. The circulating water from the cooling tower was used in the vacuum pan system where much of the proteinaceous material was concentrated as part of the manufacturing process. The tower water acted as a barometric condenser so that material boiled out of the vacuum pans was caught in the water and traveled through the cooling tower water circuit. Slime development was so great that the slats and interdecking were completely filled and water cascaded in sheets down through the central part of the tower.

Chlorophenate concentrations of 50 to 100 ppm had been found to be ineffective in controlling the slime-forming organisms. Hall engineer, E. S. Stewart, tried calcium hypochlorite. He experienced fantastic chlorine demand and the development of large amounts of foam. The foaming was controlled easily with Hagan C-1 Antifoam®, but the tremendous chlorine demand rendered the procedure impractical.

Stewart tried formaldehyde as a disinfectant. At a concentration of 40 ppm, this chemical has inhibited slime development sufficiently that plugging of the tower is prevented. Further improvement in conditioning can now be accomplished by proceeding on an orderly rather than an emergency basis.

### Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

*Water is your industry's most important raw material. Use it wisely.*

Hall Laboratories, Inc.—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more data circle 565 on Post Card

*continued from page 118*

costs; shop painting of steel in fabricating plants; painting of railroad bridges and structures; painting of highway bridges and structures; painting of steel vessels for salt water service; painting of steel vessels for fresh water service; painting of steel tanks; painting of steel in hydraulic structures; protection of pipelines and other underground structures; water and sewage works structures; maintenance painting of steel and coke oven plants; petroleum refineries; chemical plants; color in industrial plants; metallizing; and causes and prevention of paint failure.

This book is published by the Steel Structures Painting Council, a body whose purpose is to carry out research on surface preparation and the painting of steel structures and to prepare and distribute specifications and recommendations of standard practice in the cleaning and painting of structural steel.

This first volume describes current good surface preparation and painting practice in various industries; the second volume includes a description of all the types of important paint systems which have been found to give good results in the industries studied, a guide with indexes for the selection of suitable systems for various types of structures and exposure conditions, also specifications for surface preparation and pretreatment, paint application and paints.

★ ★ ★

**Magnetic Amplifiers** by Dr. Herbert F. Storm. Size 6 by 9¼ in., 545 pages; cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $13.50.

The purpose of this book is to explain the fundamentals underlying the operation of magnetic amplifiers and to illustrate their principal uses. It is written for practicing electrical engineers and for senior students of electrical engineering.

The book gives a useful presentation of the theory of magnetic amplifiers, along with theoretical and practical data on core materials, core-making techniques, and metallic rectifiers.

Although the theory of the magnetic amplifier is the focal point of the book, related fields affecting the performance of magnetic amplifiers are also fully discussed. Subjects discussed include: a modern theory of magnetism; characteristics of magnetic materials; magnetic testing; manufacture of saturable reactors, and properties of metallic rectifiers. Because of the close relation between magnetic amplifiers and a-c saturating reactors, a complete chapter is given to peaking transformers, voltage stabilizers, nonlinear resonance circuits, and reactors for large mechanical rectifiers.

Behavior of magnetic amplifiers is explained from fundamental physical principles, avoiding complex mathematics, and in general the book is written at graduate level. Magnetic amplifiers are also represented in servo-block diagram form, suitable for immediate integration into a servo system.

The book is very well illustrated, and contains abundant references to domestic and foreign sources. It is one of a series written by General Electric authors for the advancement of engineering knowledge. The author, Dr. Herbert F. Storm, is the Magnetic Amplifier Specialist of the General Engineering Laboratory of the General Electric Co., Schenectady. Dr. Storm is also Adjunct Professor of Electrical Engineering at the Rensselaer Polytechnic Institute, Troy, N. Y. He has done extensive research work in magnetic amplification, he has frequently lectured on the subject, has published more than a dozen formal AIEE Transaction papers and articles in this field, and so far has received 19 patents. In addition to Dr. Storm's writing, the book contains contributions by nine top GE specialists.

★ ★ ★

**Electric Transmission and Distribution,** edited by Bernhardt G. A. Skrotzki. Size 6¼ in. by 9¼; 448 pages. Published by McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York, N. Y. Price $7.50.

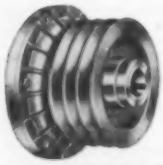
This book deals with the transmission and distribution of electrical energy from the generating station to the ultimate consumer. It is one of four books making up the Electric Utility Library, written for the reader who wishes to gain a broad understanding of the design and operation of utility systems. In addition to their value to those already partly familiar with utility operation, they should prove helpful to the engineering student entering the utility industry.

The major portion of this book describes the equipment used in transmission and distribution systems. Descriptions are arranged so that the reader is helped to understand the actual layout of equipment and what it does in the system.

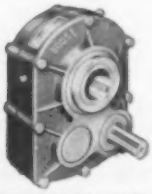
As a preliminary to the descriptive part, basic electricity is discussed in a simple manner to outline the theory on which the practical equipment has been designed. Mathematics has been limited to simple arithmetic and elementary trigonometry needed to make the simpler calculations. A high-school graduate should have no trouble with the calculations, and a grammar-school student should be able to master them with a little study. To emphasize the main points, each chapter ends with a set of review questions based on the material discussed in the chapter, and the answers can be found in the chapter.

Electrical mechanics and technicians should find this book valuable in gaining a better understanding of the equipment they work with, and everyone associated with the utility industry should find much in this book that is helpful and interesting.

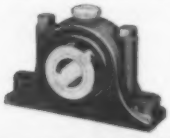

DODGE PRODUCTS you should know



FLEXIDYNE
DRIVES & COUPLINGS



TORQUE-ARM
SPEED REDUCERS



DODGE-TIMKEN
PILLOW BLOCKS

DODGE BULLETINS YOU SHOULD HAVE

- ☑ Flexidyne Dry Fluid Drives and Couplings. Complete story and selection data. Bulletin A-640-A.
- ☑ Torque-Arm Speed Reducers. Technical data and selection methods on all 14 sizes—1 to 60 hp. Bulletin A-637.
- ☑ Rolling Bearings. Load ratings, dimensions and other data on Dodge-Timken and SC and SCM Ball Bearings. Bulletin A-638.

*Write for your copies.*

DODGE MANUFACTURING CORPORATION
6400 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

For more data circle 566 on Post Card

# TAPER-LOCK

A PATENTED PRODUCT OF DODGE

## -OFF THE SHELF

NO REBORING!
NO KEYSEATING!
NO MACHINING!

Ready for the shaft, with no costly, time-consuming operations to make them fit. That's the big news about Dodge Taper-Lock Sprockets. Taper-Lock grips the shaft with the firmness of a shrunk-on fit, yet comes off easily. Bushings may be re-used. They come in sizes to meet most every application.

Taper-Lock Sprockets are available from Distributors' stocks in a complete range of B-type steel sprockets —½" to 2" pitch. Dodge quality Roller Chain is packaged in 10-foot lengths—also available in 50-foot and 100-foot reels. Save time—save money—keep production rolling—get Dodge Taper-Lock Sprockets and Roller Chain from your Dodge Distributor.

**DODGE MANUFACTURING CORPORATION, 6400 Union St., Mishawaka, Ind.**

**CALL THE TRANSMISSIONEER,** your local Dodge Distributor, for valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

***THERE'S ONLY ONE TAPER-LOCK, THE BUSHING THAT MOUNTS FLUSH!***

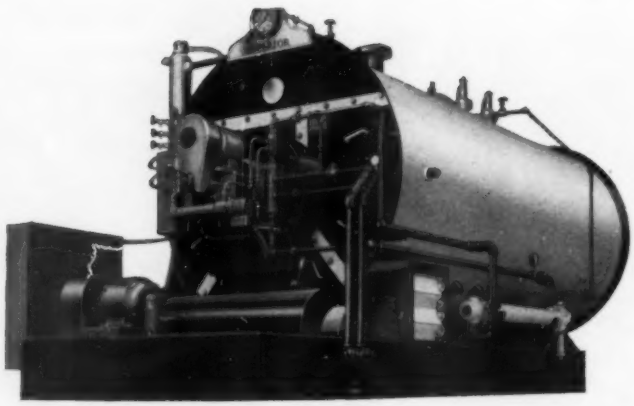
Standardize; economize with Taper-Lock, the bushing that is interchangeable in Dodge sprockets; sheaves, couplings and conveyor pulleys. *More than 2,000,000 in use!*

**DODGE**

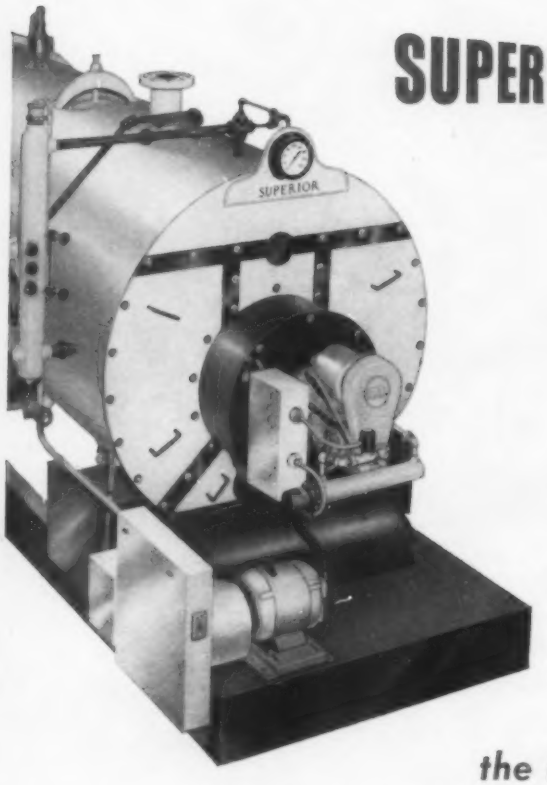
*of Mishawaka, Ind.*

**For more data circle 567 on Post Card**

# CLEANER
# QUIETER
# SAFER



## . . . and built for years of extra service




**SUPERIOR STEAM GENERATORS** are the only packaged units with an integrated and built-in *induced* draft system (as shown at the left).

Superior's induced draft maintains a negative pressure in all 4 passes of the boiler as well as in the combustion chamber eliminating the need of spring-loaded pressure relief doors commonly used on forced-draft types, and eliminating the forcing of dirt, soot or combustion gases into the boiler room.

The multiple fans operating at lower tip speeds also eliminate much of the noise and the high speed "whine" found where high speed turbines are used.

A very important advantage of Superior's *induced* draft system is in the evenness of its draw across all of the tubes in the fourth pass. This even distribution of the hot gases eliminates the danger of overworked or burnt out tubes and adds years to the life of the boiler.

Superior Steam Generators are built in 18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. burning oil or gas or both.

Write today for Catalog 806 F

***the most rugged and dependable packaged fire tube boiler made . . .***

*for performance you can* **BANK** *on*

**SUPERIOR COMBUSTION INDUSTRIES INC.**
**TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.**

**SUPERIOR**
**STEAM GENERATORS**

**For more data circle 568 on Post Card**

# CATALOG LIBRARY

**Standard catalogs listed monthly to help you maintain a reference library**

## LUBRICATION

**201 Turbine Lubrication** — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

**202 Bearing Lubrication** — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

**203 Lithium Soap Greases** — This product information bulletin details qualities and specifications of company's multipurpose lithium soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures discussed, together with performance characteristics. Sinclair Refining Co.

**204 Versatile Industrial Oil** — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

## COAL, ASH HANDLING

**205 Fly Ash Collection** — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

**It's easy to get these free catalogs—just circle item numbers of those wanted on the post card at right.**

**206 Tractor Shovel** — The engineering, design and production stories of company's HD-11G tractor shovel are pictorially presented in 8-pp Catalog MS-460. Includes specifications and describes var-

JUNE, 1956
Card void after
November 30, 1956

**POWER ENGINEERING**

**Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.**

Name.....Title.....

Company Name.....
(Must be included)

Company Address.....

City.....State.....
(If you prefer delivery at home, give home address, too)

Home Address.....

City.....State.....

| Equipment | Helpful Bulletins | Catalog Library | Advertised Products and Services |
|---|---|---|---|
| 1 2 3 4 | 101 102 103 104 105 106 107 | 201 202 203 204 205 206 207 208 209 210 211 | 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 |
| 5 6 7 8 | 108 109 110 111 112 113 114 | 212 213 214 215 216 217 218 219 220 221 222 | 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 |
| 9 10 11 12 | 115 116 117 118 119 120 121 | 223 224 225 226 227 228 229 230 231 232 233 | 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 |
| 13 14 15 16 | 122 123 124 125 126 127 128 | 234 235 236 237 238 239 240 241 242 243 244 | 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 |
| 17 18 19 20 | 129 130 131 132 133 134 135 | 245 246 247 248 249 250 251 252 253 254 255 | 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 |
| 21 22 23 24 | 136 137 138 139 140 141 142 | 256 257 258 259 260 261 262 263 264 265 266 | |
| 25 26 27 28 | 143 144 145 146 147 148 149 | 267 268 269 270 271 272 273 274 275 276 277 | |
| 29 30 31 32 | 150 151 152 153 154 155 156 | 278 279 280 281 282 283 284 285 286 287 288 | |
| 33 34 35 36 | 157 158 159 160 161 162 163 | 289 290 291 292 293 294 295 296 297 298 299 | |
| 37 38 39 40 | 164 165 166 167 168 169 170 | | |
| 41 42 43 44 | 171 172 173 174 175 176 177 | | |

Use this space to ask for tear sheets and other information.

.....

.....

FIRST CLASS
PERMIT No. 353
Sec. 349 P.L. & R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

**POWER ENGINEERING**

**110 South Dearborn**

**CHICAGO 3, ILLINOIS**

ious features which mean easier servicing for less time-down and greater operator comfort. Allis-Chalmers Mfg. Co.

**207 Spreader Stoker** — Sixteen-pp Bulletin 800 describes manufacturer's Type €-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lbs of steam per hour. Detroit Stoker Co.

**208 Coal Crusher** — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

## VALVES, TRAPS, PIPING AND ACCESSORIES

**209 Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

**210 Lubricated Plug Valves** — Catalog PV-4, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

**211 Valve Chart** — Form 194, 24 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

**212 General Purpose Valves** — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

**213 Valve Charts** — Now available to power engineers are three well-organized wall charts on valve types, selection and protection. "How to know valves" covers four main types of valves from the standpoints of their appearance, inside construction, service intended, operation and use. "How to select valves" discusses five major factors involved in the choice of a valve — fluid, temperature, pressure, size and function. "How to protect valves" — written in "do and don't" style covers 11 important points in valve installation, operation and maintenance. R-P & C Valve Div., American Chain & Cable Co., Inc.

**214 Choosing the Right Valve** — Presenting valve selection as a matter of matching the valve's service characteristics


JUNE, 1956
Card void after
November 30, 1956

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name.................................Title..................
Company Name..........................................
(Must be included)
Company Address........................................
City..................................State..................
(If you prefer delivery at home, give home address, too)
Home Address...........................................
City..................................State..................

| Equipment | | | | Helpful Bulletins | | | | | | | Catalog Library | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 |
| 5 | 6 | 7 | 8 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 |
| 9 | 10 | 11 | 12 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 |
| 13 | 14 | 15 | 16 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 |
| 17 | 18 | 19 | 20 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 |
| 21 | 22 | 23 | 24 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 |
| 25 | 26 | 27 | 28 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 |
| 29 | 30 | 31 | 32 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 |
| 33 | 34 | 35 | 36 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 |
| 37 | 38 | 39 | 40 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | | | | | | | | | | | |
| 41 | 42 | 43 | 44 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | | | | | | | | | | | |

Advertised Products and Services

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 |
| 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 |
| 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 |
| 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 |
| 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 |

Use this space to ask for tear ..............................
sheets and other information. ..............................

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P. L. & R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

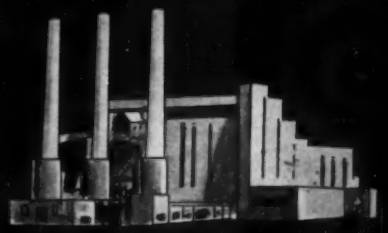
POSTAGE WILL BE PAID BY —

POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS

# GET GREATER SAFETY AT LOWER COST...

CHOOSE THE TYPE 1511

## CONSOLIDATED SAFETY VALVE



**TYPE 1511 CAST IRON BODY SAFETY VALVE**
**SIZES:** 1½" through 6". **PRESSURES:** up to 250 psi. **TEMPERATURES:** up to 450° F. All sizes except 6" available with oversize flanges.

Maximum safety comes first in power engineering. But lower initial equipment investment and lower maintenance costs are also essential factors. The Type 1511 Consolidated Safety Valve gives you all three. It is an all-purpose safety valve, expressly designed for steam generator service, yet costs less than other makes for the same service.

Among the many advantages of the Type 1511 are:

| | |
|---|---|
| **1** | Positive tightness because the seat is precision lapped to optical flatness. |
| **2** | Stable operation and uniform blowdown control because the spring is exposed. |
| **3** | Better alignment, easier blowdown adjustment and finer performance because the valve has an integral, double-guided combination adjusting ring and disc guide. |
| **4** | Cuts the cost per pound of steam discharged because maximum capacity is designed into minimum flange size. The size and/or number of safety valve nozzles required on any boiler are reduced. |
| **5** | Saves space – requires less headroom and smaller discharge piping. |

The Type 1511 Consolidated Safety Valve is made in a full range of sizes and orifices. Write for Bulletin 730 and learn the complete story of the greater safety and economy of the Type 1511.

**In Canada:** *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.*

# CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

**For more data circle 569 on Post Card**

with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed. Crane Co.

**215 Industrial Valves** — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

**216 Boiler Blow-Off Valves** — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

**217 Steel Gate Valves** — Four types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 C, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

**219 Butterfly Valves** — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

**220 Steam Trap Selector** —Twelve-pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

**221 Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

**222 Stainless Steel Pipe Fittings** — Bulletin S-3-55 describes company's 150 lb stainless steel pipe fittings for corrosive, high and low temperature service, including 90 deg elbows, tees, 45 deg elbows, crosses, couplings, reducers, pipe caps, unions, plugs and bushings. Presents dimensional specifications in sizes ⅛ to 2 in. in both screw end and socket welding types. Applications in chemical plants, refrigeration service, food and other process piping given. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

**223 Expansion Joint Guide** — Catalog 153, 24-pp, a complete design guide for application and selection of expansion joints, is filled with engineering data necessary to solution of pipeline expansion problems. Includes a discussion of types of expansion joints available and types of pipeline motion solved by expansion joints. Includes a schematic piping layout illustrating expansion joint applications and principles, as well as full specifications. Flexonics Corp.

**225 Flexible Ball Joint** — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg. Co.

## ELECTRICAL EQUIPMENT

**226 Motor-Generator Reference Book** — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither textbook nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, as well as detailed information on speed control. Allis-Chalmers Mfg. Co.

**227 Plug-In Busway** — Twenty-pp Bulletin GEA-6170 describes the factory-


PROOF POSITIVE

foster MASTIC COATING RESISTS FIRE

Arc welding above freshly-applied Foster 60-60N (left) fails to ignite coating; while ordinary asphalt mastic (right) ignites and burns fiercely until consumed.

foster Fire-Resistive Mastic 60-60N is:

Non-flammable during (and after) application by spray or trowel—no danger of ignition from welding sparks or splatter.

Fire-resistive when dry, won't add fuel to accidental fire exposure. (Foster 60-60 is still the only weather-coating listed by Underwriters' Laboratories).*

An effective barrier to moisture vapor; a requirement for coating low temperature thermal insulations, (vapor permeance 0.02 perm).

Outstanding for protecting steel and thermal insulation from weather and chemicals (both liquid spillage and atmospheric fumes);

Unparalleled by any conventional mastic coating for retained flexibility under prolonged heat and sunlight.

A companion product, Foster's Fire-Resistive Mastic 60-60 is listed and inspected by the Underwriters' Laboratories, Inc.

Underwriters' Laboratories, Inc. INSPECTED WEATHER PROTECTIVE COATING

foster FIRE RESISTIVE MASTIC 60-60

*Dry film of 60-60N is identical with dry film of 60-60. 60-60N is an improved mastic made with non-flammable, non-toxic volatile solvent.

BENJAMIN foster COMPANY

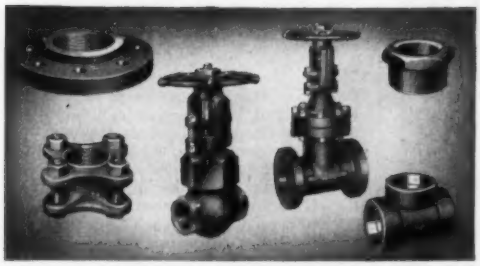
4635-37 W. Girard Avenue

PHILADELPHIA 31, PA.

Distribution and Technical Services available in principal U. S. and Canadian Industrial Areas.

For more data circle 570 on Post Card

# Designed for today's *Tough* service demands



**DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE**

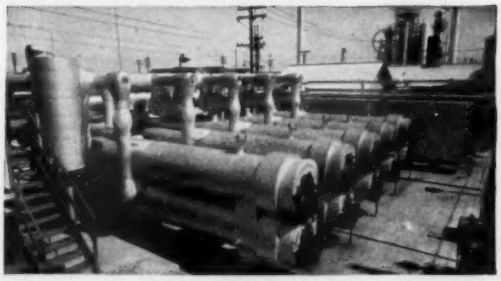
Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

**MODERN STEAM GENERATORS**

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

**PROCESS EQUIPMENT FOR EVERY SERVICE**

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



**SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION**

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.

**MORE REFRIGERATION TONNAGE AT LESS COST**

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

# Vogt

## PRODUCTS

**FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES**

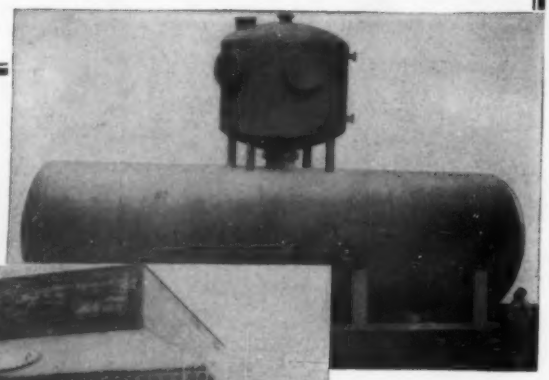
**Write Dept. 24-GPE for catalogs**

**HENRY VOGT MACHINE CO.**
**LOUISVILLE 10, KY.**

**SALES OFFICES: New York, Philadelphia, Cleveland, Chicago, St. Louis, Charleston, W. V., Cincinnati, Dallas, San Francisco**

**For more data circle 571 on Post Card**

# SATISFIED PUERTO RICO SENDS ANOTHER ORDER FOR CONSECO



*Right: 500,000 lb/hr deaerating feedwater heater with 22,000 gal. storage tank.*

*Left: CONSECO supplied a 45,000 sq. ft. condenser, air ejector for Unit No. 5.*

## FOR THE SAN JUAN STEAM ELECTRIC STATION

The San Juan Steam Electric Station of the Puerto Rico Water Resources Authority has been so satisfied with Conseco condensing and feed water heating equipment already installed and operating with Units 1, 2, 3, and 4, they ordered additional Conseco equipment, shown above, for Unit 5. The heating section on top of the 36½ ft. storage tank is 9 ft. in diameter, 10 ft. high, A.S.M.E. Code. This is the largest heating unit in the plant, part of the feedwater heating system for the 44,000 KW turbo generator system.

**CONSECO DESIGNS AND BUILDS**

Heat Exchangers • Condensers • Evaporators • Steam Jet Air Ejectors • Steam Generators • Pressure Vessels • Centrifuges Filters • Strainers • Pumps • Instruments and Specialties Send for Catalogs.

**CONDENSER SERVICE & ENGINEERING CO., INC.** CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

158 OBSERVER HIGHWAY
HOBOKEN, N. J.

For more data circle 572 on Post Card


assembled Flex-A-Power plug-in busway system permitting direct connection to bus bars for feeding lighting and power loads in industrial plants and public buildings. Describes in detail the construction and application of this busway system. Also lists ratings, weights, dimensions, installation data and guide form specifications. General Electric Co.

**228 Testing Instruments** — Bulletin 19–56, 16-pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

**229 High-Capacity Fuses** — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

### PUMPS, COMPRESSORS

**230 Boiler Feed Pump** — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

**231 Controlled Volume Pumps** — Bulletin 953, 24-pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

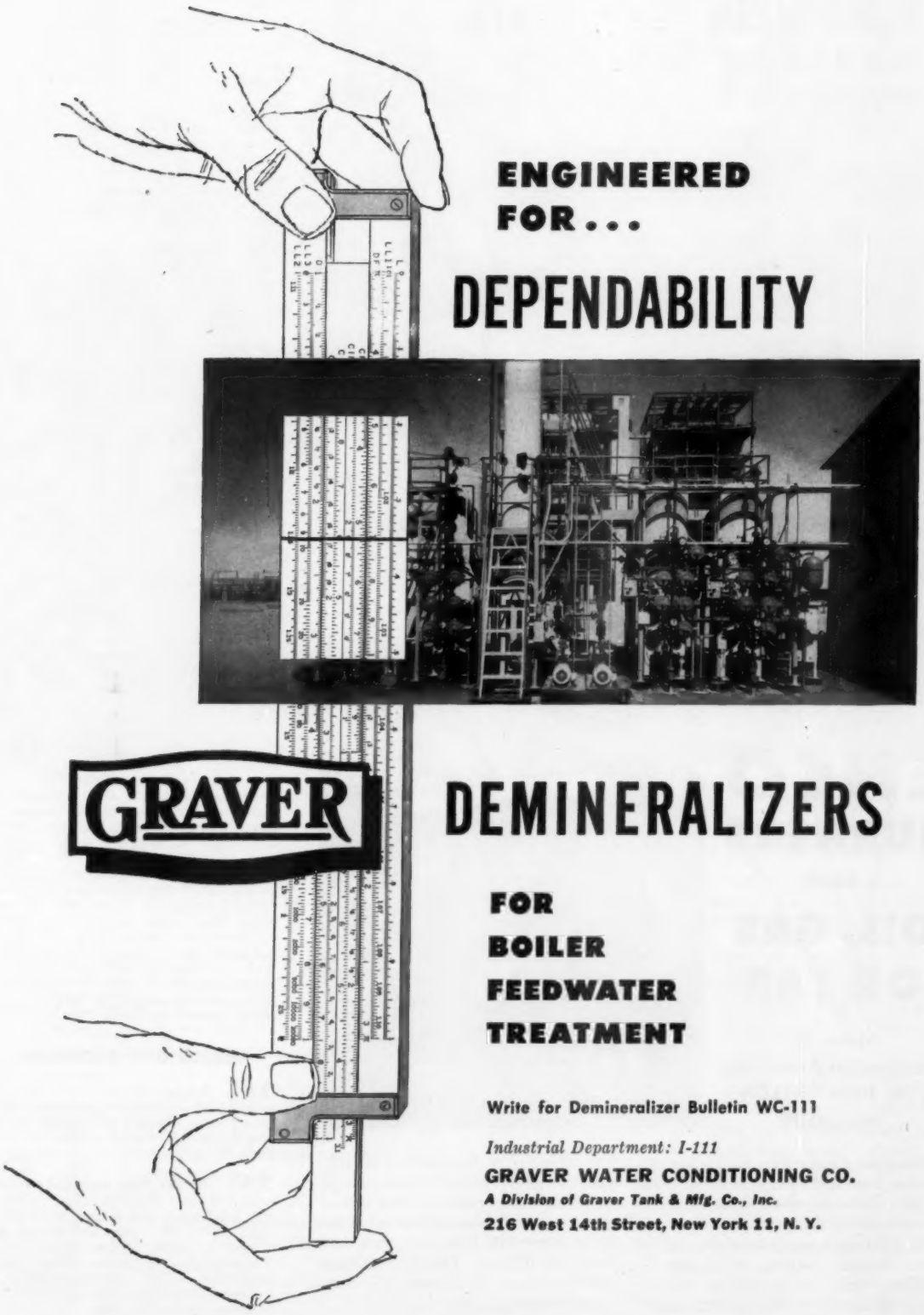
**232 Boiler Feed Pump** — Bulletin 08B7899, 16-pp, describes design features and principal advantages of company's barrel type boiler feed pumps. Shows why balanced thrust design gives radial and axial balance for greatest reliability and for smooth operation and longer pump life. Allis-Chalmers Mfg. Co.

**233 Sump Pump Selector** — Bulletin 54-3-1420, 20 pp, provides a selection table allowing a power engineer to choose any of the 4000 models of the BJ Sumpmaster pumps, which range from 10 to 2600 GPM with heads from 20 to 300 ft. Includes dimensional drawings. Byron Jackson Co.

**234 Horizontal Compressors** — Bulletin L-640-B1C, 24 pp, presents single-stage horizontal compressors from 50 to 2000 cfm and from 10 to 150 psi. Gives information on basic specifications, standard equipment, capacity control, cylinder construction, other factors. A diagram of a complete installation is included along with cutaway views of major components and accessories. Worthington Corp.

### BOILERS, GENERATORS

**235 Packaged Boilers** — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Follow-



**ENGINEERED FOR . . .**

# DEPENDABILITY

# GRAVER DEMINERALIZERS

**FOR BOILER FEEDWATER TREATMENT**

**Write for Demineralizer Bulletin WC-111**

*Industrial Department: I-111*

**GRAVER WATER CONDITIONING CO.**

***A Division of Graver Tank & Mfg. Co., Inc.***

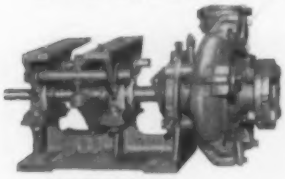
**216 West 14th Street, New York 11, N. Y.**

**For more data circle 573 on Post Card**

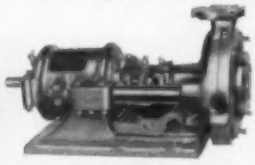
# THIS USER GOT THEIR NAGLE PUMPS *free!*

A large plant using several types of Nagle Pumps theoretically got them free, based on the cost of the replacements and repairs of the ordinary pumps they were using. Since installing Nagle Pumps there have been no replacements or repairs.

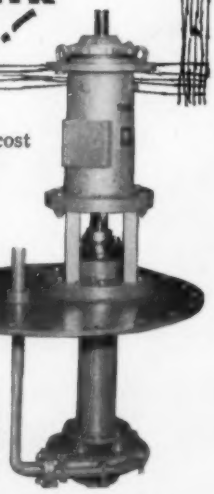
Nagle Horizontal Shaft and Vertical Shaft Pumps are designed for the tough, abusive jobs where ordinary pumps fail—jobs involving abrasion, corrosion or hot liquids. Types and sizes for every need—if it is an abusive application. Send for Catalog 5206.



TYPE "KR"



TYPE "TW"



TYPE "CWOC"

NAGLE PUMPS

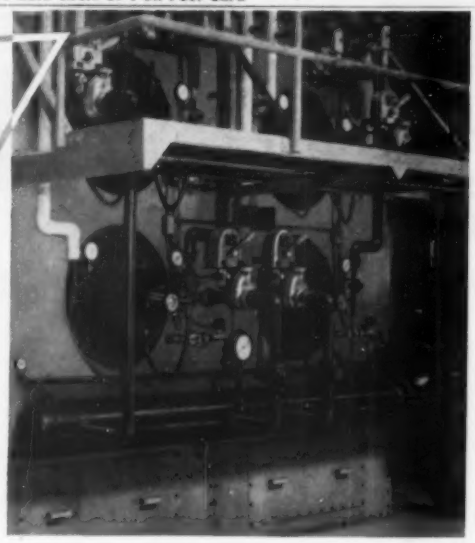
**NAGLE PUMPS, INC.**
1229 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

For more data circle 574 on Post Card

# ENCO BURNERS FOR OIL, GAS OR TAR

**Steam Or Mechanical Atomizing 1 TO 1000 GALLONS PER HOUR**



Designed for operation with either gas, oil or both with natural or forced draft. They can be depended on for maximum combustion efficiency.

ENCO Interchangeable Oil-Burners can be changed instantly to operate by either steam or mechanical pressure atomizing over a wide capacity range.

ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

Send for Bulletin OB-53 describing ENCO Gas and Oil Burners, also complete Pumping and Heating Units.

KC 911

**THE ENGINEER COMPANY,** 75 West Street, New York 6, N. Y.

For more data circle 575 on Post Card


ing a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 40,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

**236 Compact Generator** — This bulletin describes a packaged water tube generator, company's Type DK, available in units for 8400 to 45,000 lb of steam per hour. Gives features, size and capacity data on these boilers which are designed to require less space than many water tube units. E. Keeler Co.

**237 Improved Steam Generator** — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

**238 Steam Generators** — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

**239 Steam Generators** — Type WTP shop-assembled water tube steam generators are detailed in 14-pp Bulletin 5511. Includes technical data, a dimensional drawing with a table of dimensions, a drawing showing tube arrangement and gas passes, and illustrations of basic components. The Titusville Iron Works Co.

**240 Water Tube Boilers** — This 12-pp catalog describes packaged water tube boilers, capacities to from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

**241 Packaged Generators** — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

## TUBING AND ACCESSORIES

**242 Rotary Tube Cleaners** — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

**243 Nickel Pipe and Tubes** — Bulletin T-17 is a 28-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

**244 Life Extension for Condenser Tubes** — The 32-pp current edition of

W. F. MUNFORD

*Portrait by Fabian Bachrach*

# "A Dynamic Potential . . ."

. . . is created daily by millions of Americans in their purchases of U.S. Savings Bonds through the Payroll Savings Plan. Better than three out of four of United States Steel's American Steel and Wire Division employees are taking advantage of this easy automatic plan of saving.

"We in management feel that every employee, whether newly hired or already on the payroll, must be advised constantly as to the values of this Savings Bond Program. A program designed to maintain high employee participation is an integral part of our everyday operations."

**W. F. MUNFORD,** ***President***
***American Steel and Wire Division***
***United States Steel Corporation***

Does *your* company present the advantages of The Payroll Savings Plan (and a Payroll Savings Application Blank) to every *new* employee? Are 75% of *your* employees enrolled in *your* Payroll Savings Plan?

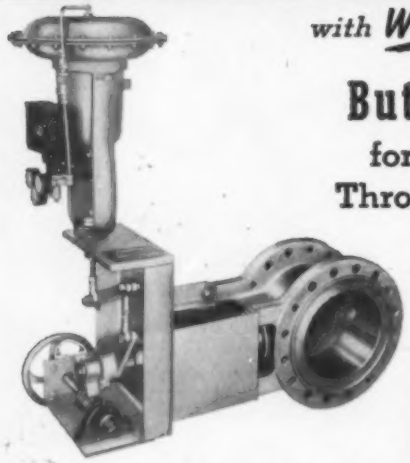
Write to Savings Bond Division, U.S. Treasury Department, Washington 25, D. C. Your State Sales Director will be glad to help you take your place with American Steel and Wire and the more than 40,000 other companies that have successful Payroll Savings Plans.

*The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and*

**POWER ENGINEERING**

# Meet Any Flow Conditions

*of Pressure · Temperature · Corrosion*



12" stainless steel valve for hot gas at 265 p.s.i.; has automatic air operator, auxiliary hand wheel and valve disc positioner.

*with* **W. S. ROCKWELL**

## Butterfly Valves

### for Tight Shutoff— Throttling—Regulating

Minimum pressure drop • Self-cleaning • Compact • Lighter weight • Less space • Easy to install.

Made in all sizes from 4" to 144"; pressures to 300 p.s.i. and higher, in any metal or rubber covering; with any manual or automatic operators. There's a wide choice for your applications on air, gases, liquids or solids. Write for Catalog.

**W. S. ROCKWELL COMPANY**

ROCKWELL SINCE 1888 BUILT

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2946 ELIOT STREET • FAIRFIELD, CONN.

*Sales Representatives in Principal Cities*

For more data circle 577 on Post Card


this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

**245 Tube Cleaners** — Catalog 76-A provides 48 pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Thomas C. Wilson, Inc.

### WATER CONDITIONING

**246 Handbook on Demineralizing** — Comprehensive 40-pp Bulletin 5800-B compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use 2-bed, 3-bed, 4-bed, mixed or monobed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

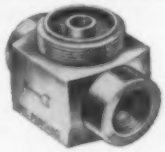
**247 Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.


# NEW-REVOLUTIONARY STEAM TRAP

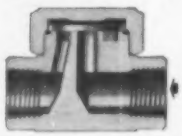
**1. A CAP**

**2. A DISC**

**3. A BODY**



*THAT'S ALL!*



Only moving part, a hardened Solid Stainless Steel Disc, practically wear-proof!

8134-F

## defeats wear-corrosion!

This **NEW** Sarco Thermodynamic Steam Trap virtually eliminates maintenance. Stainless steel throughout. Only one moving part.

No valve-closing mechanisms to wear or stick. Not affected by superheat, water-hammer, vibration, corrosive condensate. No critical clearances to choke. No gaskets to leak. Same trap for all loads and pressures 10-600 psi.

Write for bulletin 255-44 or a TD trap for a 60-day trial installation. Specify size and application.

**SARCO COMPANY, INC.**

EMPIRE STATE BLDG., N.Y. 1, N.Y.

For more data circle 578 on Post Card

*Sign Your*

# DECLARATION OF INDEPENDENCE

☆

# Buy U. S. Savings Bonds!

**248 Water Conditioning Data Book** — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

**249 pH and Chlorine Control** — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness in feedwater. Available to qualified power engineers. W. A. Taylor Co.

**250 For Industrial Water Softening** — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

**251 Feedwater Treatment** — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical and complete, and points out how it improves steam quality and reduces boiler maintenance costs and downtime. National Aluminate Corp.

## REFRACTORIES, INSULATIONS

**253 Refractory Notes** — Included in Vol. XV of this company's Thermogram is an illustrated article on a method for decreasing hot topping costs in steel mills with minimum capital expenditure. Another story tells how bonded brick assemblies cut installation time in a coke plant. Refractory & Insulation Corp.

**254 Refractory Concrete** — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

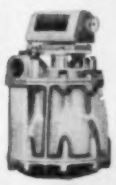
**255 Insulations, Refractories** — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from — 400 F to 3,000 F. Johns-Manville.


BOWSER ESTABLISHED 1885

LEADING IN LIQUID-HANDLING EQUIPMENT FOR INDUSTRY

METERING 1

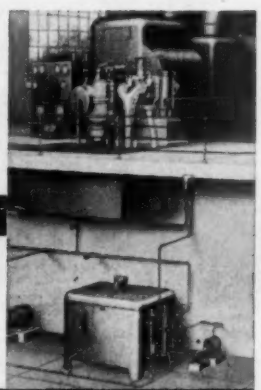
Bowser meters record and control fuel and industrial liquids for accurate accounting.



FILTERING 2

Bowser-filtered fuel protects costly equipment. Replaceable cartridges deliver clean, polished filtrate at low cost. Used for fuel and process liquids.

Wherever liquids are handled for power, process or production, Bowser engineers work with plant engineers to improve efficiency.



3 LUBRICATION

Bowser systems keep lube oils dry and clean. Stop bearing failures. Oil lasts longer. Power equipment is protected.

Write for data.

REGIONAL OFFICES
ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
KANSAS CITY • LOS ANGELES • NEW YORK • SAN FRANCISCO

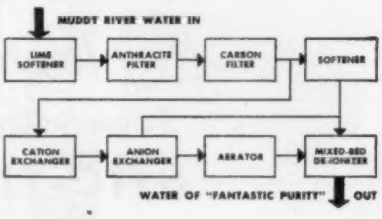
BOWSER, INC., 1351 E. CREIGHTON, FORT WAYNE, INDIANA

For more data circle 579 on Post Card



ILLCO-WAY ionXchange

HOW TO UN-MUDDY THE WATERS




This block diagram shows a typical arrangement for a power company steam plant that must draw its boiler feed water from a nearby muddy river. The Lime Softener takes out suspended solids, turbidity, alkalinity, and organic matter; the Anthracite Filter removes any remaining turbidity; the Carbon Filter removes the chlorine; the Softener provides process water; the Cation and Anion Exchangers remove the dissolved solids such as carbonates, sulfates, and chlorides; the Aerator takes out most of the $CO_2$; and the Mixed-Bed De-Ionizer eliminates the remaining 4 or 5 ppm of solids, silica, and 5 ppm of $CO_2$ — to produce water of "fantastic purity."

ILLCO-WAY PIONEERS IN PRACTICAL EXPERIENCE

Illinois Water Treatment Company designs and builds *complete, practical, workable systems* such as that shown above — to operate economically on a cost-reducing basis. This work is based on a wealth of practical knowledge gained through constant experience in the specialized field of ion-exchange, starting from the time that the first workable resins became available.

*Remember ILLCO-WAY—foremost in the field of ionXchange.*

ILLINOIS WATER TREATMENT CO.

ionXchange

ILLCO-WAY

840 CEDAR ST.
ROCKFORD,
ILLINOIS

NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N.Y.
CANADIAN DIST.: PUMPS & SOFTENERS, LTD. LONDON, ONT.

For more data circle 580 on Post Card

# SMOOTHEST ONE COAT INSULATING FINISH

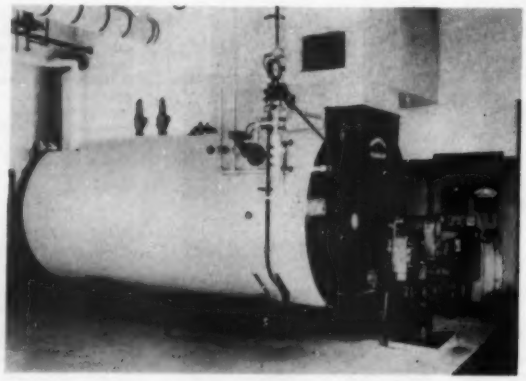
*New Improved*

**Super-Finish**

**STIC-TITE**

- One Coat—not two—saves time and money
- Very smooth—white—pleasing appearance
- Applies quickly, easily
- Dries hard
- Sticks *tight* to all surfaces
- No shrinking—No cracking
- Double the coverage of asbestos cement
- Moisture and steam resistant
- High insulating value

*Use on*
BOILERS
TANKS
HEATERS
FANS
PIPING
FITTINGS
ETC.



Boiler insulated with R & I Mineral Wool Blankets and covered with Super Finish Stic-Tite.

**REFRACTORY & INSULATION CORP.**

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

130 WALL STREET • NEW YORK 5, N. Y.

For more data circle 581 on Post Card


## INSTRUMENTS AND CONTROLS

**257 Metering and Control Equipment** — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

**259 Boiler Feed Control** — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater automatically. Copes-Vulcan Div., Blaw-Knox Co.

**260 Instruments, Controls** — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

**261 Easy Reading Gage** — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

**262 Resistance Temperature Detectors** — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance temperature detectors are presented, along with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

**263 Indicating Flow Meter** — Bulletin 18-A, 22-pp, discusses advantages, construction and operation of company's Type H indicating flow meter. Presents technical data on the principles and theory of fluid measurement and discusses orifice type meters and orifice meter principles. Offers examples of flow rate calculations. Schematic drawings and diagrams, tabulated technical data and specifications are included. The Meriam Instrument Co.

**264 D-C Amplifier** — Twelve-pp Bulletin MSP 111.1 provides pictorial diagrams and descriptive information on company's PowrAmp Model P, an electronic low-voltage linear amplifier designed to increase the speed and accuracy of low level d-c voltage measurements. Discusses performance and construction features of the amplifier, and describes some applications. Specifications and ordering suggestions given. Hagan Corp.

**265 Solenoid Pilots** — Several types of solenoid pilots for use with company's regulating valves are described in Form 1010. Lists reasons for economies in on-off control, describes applications, and gives type of pilot, material of construction, maximum pressure and maximum temperature for two- and three-way pilots in steam, air, gas and liquid service. Schematic diagrams of typical applications are given. Spence Engineering Co., Inc.

CONSULT US FOR:
CHIMNEYS
FURNACE WORK
BOILER SETTINGS

AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES: CHICAGO
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • RICHMOND, VA. • CINCINNATI, OHIO

For more data circle 582 on Post Card

**266 Ideas on Push-Pull Controls** — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

**267 Bi-Color Gage** — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features, illustrates construction details through photos and drawings. Installation methods are also treated. Diamond Power Specialty Corp.

## OTHER EQUIPMENT

**268 Steam Accumulator** — How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

**269 Heat Transfer Apparatus** — Condensed Bulletin HT-1 highlights representative products in company's line of heat transfer equipment. Includes oil heaters and coolers, strainers, evaporators, heat exchangers, radiafin air coolers, tubes, pipes, and coils. Cross-section views of typical units are shown, brief descriptions given. Schutte and Koerting Co.

ERNST
HIGH PRESSURE
GLASSES
and GASKETS
All sizes to fit your gages and valves

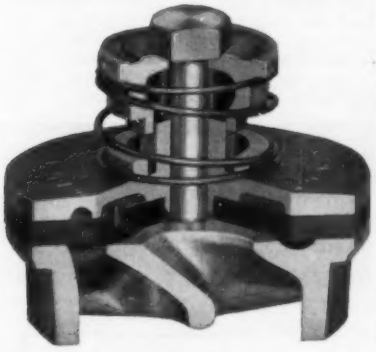
FIG. 22 SERIES 750

FIG. 21 LIP-MOLD

STATE YOUR REQUIREMENTS
All shipments from stock.
Send for Catalog
ERNST WATER COLUMN & GAGE CO.
Livingston 6-1400 LIVINGSTON, N. J.

For more data circle 583 on Post Card

SIMS INCLINED PORT ROTATING PUMP VALVES



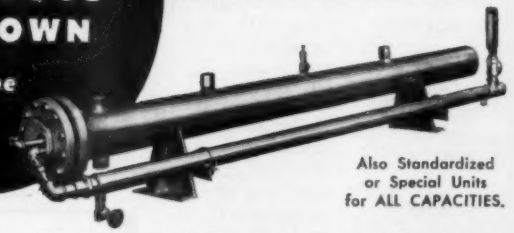
Guaranteed to:
1. REDUCE Seat and Disc Wear.
2. INCREASE Pump Capacity.
3. REDUCE Maintenance Costs.
4. WORK Efficiently in Light or Heavy Liquids.

Sims Valves are available for all reciprocating pumps from stock.
Write for New Catalog PE-5

Sims
PUMP VALVE CO., INC.
1314 Park Avenue Hoboken, N. J.

For more data circle 584 on Post Card

HENSZEY
CONTINUOUS
BLOWDOWN
packet-type



complete, automatic control of boiler water concentration

Also Standardized or Special Units for ALL CAPACITIES.

PREVENTS PRIMING
PREVENTS FOAMING
PREVENTS SLUDGE
PREVENTS SCALE
(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

HENSZEY

Consult your nearest HENSZEY Representative for FREE Blowdown Chart or write to
HENSZEY COMPANY
DEPT. B6 • WATERTOWN, WISCONSIN

Continuous Blowdown and Boiler Plant Specialties • Boiler Feed Regulators • Distillation Systems • Heat Exchangers • Feed Water Meters • Flow Indicators • Proportioning Valves
Also PROCESS EVAPORATORS, PREHEATERS, and SPRAY DRYERS

For more data circle 585 on Post Card

AIRETOOL'S new, lightweight, portable tube cutter removes heat exchanger and condenser tubes faster and more economically than ever. Self-centering, double-action hardened steel tool bits cut non-ferrous and steel tubes. Positive feed control eliminates gouging, burning . . . increases life of tool bits. Equipped with powerful *new* air-driven motor, designed and built by AIRETOOL.

Cutter is also available with electric driven motor, or in push-type design adaptible for use with your own electric or air motors.

*Send for Bulletin #59, illustrating the complete, new line of AIRETOOL Tube Cutters, cleaners, expanders, accessory and specialty tools.*

**AIRETOOL**
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.

REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands

For more data circle 586 on Post Card


**271 Preheating Combustion Air** — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

**272 Conveyor Belt Chart** — Engineering data for standard conveyor belt constructions is given in this chart and accompanying sheet. Strength characteristics of eight popular ply and material combinations of conveyor belt constructions are provided. Each property is printed on the chart in a different color to facilitate comparison. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

**273 Silent Heater** — Bulletin H-10 5 stresses noiseless and vibration-free operation of company's HusHeater. Describes applications in various industries, operation details, and includes installation and ordering information. Sims Pump Valve Co., Inc.

**274 Industrial Fans** — Bulletin 5306-H, 72-pp, describes Series 106 fans for industrial air and material handling requirements. Covers wheels and arrangements, optional construction, modifications and special design and construction details for high temperature operation. An elevated temperature application guide offers recommendations for bearings, fan construction, fan arrangement and maximum speed factor in high temperature installations. Selection, rating table terminology, ordering data and operating limits are discussed. Ratings are tabulated and photos and drawings included. American Blower Corp.

**275 On Cooling Tower Wood**—The protection of cooling tower wood is the subject of Technical Paper 130. Explains how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi. W. H. & L. D. Betz.

**276 Steam Condensers** — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment, to steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

**277 Steam Turbines** — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

**278 Technical Refrigeration** — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

**279 Packings and Gaskets** — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

**280 For Burning Refuse Fuel** — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components, the selection of grates, as well as pertinent design and engineering features. Riley Stoker Corp.

**281 After Cooler** — Bulletin 130, 8-pp, explains the functions of company's Aero after cooler in removing moisture from compressed air and gas. The apparatus is described and illustrated with diagrams and photos. Included also are diagrams and illustrations of applications in liquefaction systems. Niagara Blower Co.

**282 Belt Conveyor Carriers** — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

# A few engineers may say we're nuts!

But only because the subject of boiler blow-off is still treated as such a mystery. We say that blow-off should be continuous . . . that boilers should be blown from the top . . . that intermittent blowing is no better than guessing . . . that equipment to do the job right pays for itself in a matter of months. A lot of the country's leading power plants agree with us. See if you don't: write for "Blow-off Facts" to *The Madden Corp., 1543 W. Morse Ave., Chicago 26, Ill.*

For more data circle 587 on Post Card

## CLASSIFIED ADVERTISING

# WANTED

### ASSISTANT CHIEF ENGINEER

Graduate Mechanical Engineer, or equivalent, with a minimum of three years experience in high pressure power plant operation. A high caliber man is required in the operation and maintenance of 1250 pound pressure, pulverized fuel fired, steam-electric power plant located in the midwest.

Write stating education, experience, salary expected, and availability. All replies will be held confidential. Box 1712, POWER ENGINEERING, 110 South Dearborn Street, Chicago 3, Illinois.

FIRST TIME OFFERED
Manufacturing, sales, engineering and rentals of

### POWER PLANT EQUIPMENT

In Oklahoma City

Little competition. Only one other similar business in U. S. Services, sells and rents to municipalities, manufacturers, cleaning plants, dairies, sugar refineries, etc. Employs 48 people. Approximately $1,000,000 a year volume. Has potential of $100,000 a year net profit. Full details revealed only to interested, financially responsible individuals. Total price for equipment, parts, supply inventory, rental units, and clientele, $275,000. Owner will give long-term lease on property. Write C. R. Knapton, 224-26 Okla. Natural Bldg., Oklahoma City, Okla.

KNAPTON BUSINESS BROKERS

# APPLICATION ENGINEER

**Prominent manufacturer located Midwest has excellent opportunity for man with at least 3 years experience in internal combustion engine application engineering as related to fluid flow design of cooling water, lubricating and fuel oil, and air piping in power plants. Must have ability to calculate size of auxiliary pumps, coolers and so forth. Some knowledge of machine design and engineering mathematics essential. Must be able to handle all application engineering required by engine contracts. Write stating age, experience, and salary expected. Replies strictly confidential. Box 1710, POWER ENGINEERING, 110 S. Dearborn, Chicago 3, Ill.**

## PROFESSIONAL SERVICES

**THE LUMMUS COMPANY**
*Engineers and Constructors*
385 Madison Avenue, New York, N. Y.
Chicago — Houston — London — Paris — The Hague — Montreal — Caracas — Bombay

**J. E. SIRRINE COMPANY**
Engineers
Design and Supervision of Steam and Hydro-electric Power Plants, Industrial Plants, Mechanical and Operating Surveys, Appraisals • Plans • Reports
Greenville, South Carolina

### USED AIR COMPRESSOR WANTED

200 to 2500 CFM — 125 lb. Pressure. Direct Connected Motor for 4160V. Power Factor Correction Desirable. Write Box 1711, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Illinois.

*Complete*

### REFRIGERATION UNIT

for Ammonia, 12 to 15 tons capacity, wanted by
**EASTERN BREWING CORPORATION**
**HAMMONTON, NEW JERSEY**

# ENGINEER

*atomic era caliber*

# POWER PLANT

If you are a mechanical engineer with broad specialization in design and development of steam power stations, you can help move the coming nuclear energy revolution out of its infancy and into lusty manhood.

We are not looking for a comfortable-rut thinker. We want someone whose inner growth is just as important to him as it is to us. He is the engineer whose working knowledge of power system stability, heat transfer and turbine performance under varying pressure and flow conditions can be put to creative use in a new field. A background in electrical system reliability, characteristics and problems is also desirable.

*Write in confidence to General Electric, the organization whose unique Personnel Development and Benefit programs are designed to help you grow in the career you are looking for. Personal interviews will be arranged with all selected candidates.*

**Mr. E. P. Galbraith**
**Technical Personnel Placement**
**GENERAL ELECTRIC**
**RICHLAND, WASHINGTON**

A

# CAREER OPPORTUNITY

with

# DU PONT

for an experienced

# POWER ENGINEER

A unique career opportunity for a graduate mechanical engineer is now available in the Engineering Service Division of our Engineering Department. The applicant must have 8 to 10 years of practical power experience, including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable.

The successful applicant will assist in specification of power equipment and in selection of new facilities, and will make economic evaluations and involved heat balances for complicated power systems.

Duties will include determination of causes of equipment malfunctioning and development of recommendations for corrections.

**CLEVELAND INTERVIEWS**
Sun-Mon-Tues-Wed
June 17-18-19-20

*To arrange an appointment with our technical representative, please call*
Mr. J. C. Costello, Jr.
PRospect 1-6857

Or you may send complete resume, including details of education and experience, to:
Mr. J. C. Costello, Jr.
Engineering Department

DU PONT
Better Things for Better Living ...through Chemistry

E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

# ADVERTISERS' INDEX


**AIR PREHEATER CORP., INC.** ★
Agency—G. M. Basford Company
**AIRETOOL MFG. CO.** 136
Agency—Harry M. Miller, Inc.
**ALCO PRODUCTS INC.** ★
Agency—Hazard Advertising Co.
**ALLIS-CHALMERS MFG. CO.** 2, 20
Agency—Compton Advertising Inc.
**ALLIS-CHALMERS MFG. CO. (TRACTOR DIV.)** ★
Agency—Bert S. Gittins Advertising
**AMERICAN BLOWER CORP.** 16–17
Agency—Brooke, Smith, French & Dorrance, Inc.
**AMERICAN BRASS CO.** 43
Agency—Kenyon & Eckhardt Inc.
**AMERICAN CHAIN & CABLE CO., INC.** 52
Agency—Reincke, Meyer & Finn, Inc.
**AMERICAN CHIMNEY CORP.** 135
**AMERICAN ENGINEERING CO.** 29
Agency—Beatty and Oliver, Inc.
**AMERICAN PULVERIZER CO.** 106
Agency—Batz-Hodgson-Neuwoehner
**AMERICAN WATER SOFTENER CO., INC.** ★
Agency—Willard G. Myers Advertising Agency
**ARMSTRONG MACHINE WORKS.** 115
Agency—Russell T. Gray, Inc.
**ATOMICS INTERNATIONAL.** 63
Agency—Battern, Barton, Durstine, Osborne

**BABBITT STEAM SPECIALTY CO.** ★
Agency—George T. Metcalf Co.
**BABCOCK & WILCOX CO., THE** 36–37
Agency—O. S. Tyson and Co., Inc.
**BAILEY METER COMPANY** 22
Agency—Fuller & Smith & Ross, Inc.
**BALDWIN-HILL CO.** 40
Agency—Eldridge, Inc.
**BALTIMORE & OHIO RR.** 7
Agency—Richard A. Foley, Inc.
**BARCO MANUFACTURING CO.** 110
Agency—Armstrong Advertising Agency
**BECKMAN, ARNOLD O., INC.** ★
Agency—Dozier-Eastman & Co.
**BELL & ZOLLER COAL COMPANY** 101
Agency—George H. Hartman Co.
**BELMONT PACKING & RUBBER CO., THE** ★
Agency—The Michener Co.
**BETZ, W. H. & L. D.** 99
Agency—The Michener Co.
**BIDDLE CO., JAMES G.** ★
Agency—The Roland G. E. Ullman Organization, Inc.
**BIRD-ARCHER CO., THE** ★
Agency—The Roland G. E. Ullman Org.
**BOILER ENGINEERING & SUPPLY CO.** ★
Agency—John B. Ferguson Jr.
**BOTFIELD REFRACTORIES.** ★
Agency—R. E. Lovekin Corp.
**BOWSER, INC.** 133
Agency—Willis S. Martin Co.
**BRIDGEPORT BRASS CO.** ★
Agency—Hazard Advertising Co., Inc.
**WM. BROS. BOILER & MFG. CO.** ★
Agency—The Alfred Colle Co.
**BUSSMANN MFG. CO.** 12–13
**BYRON-JACKSON DIV., BORG-WARNER CORP.** ★
Agency—Ramsey, Brown & Co.

**C & D BATTERIES.** ★
Agency—John T. Hall & Co.
**CAMBRIDGE INSTRUMENT CO., INC.** ★
Agency—E. M. Fraystadt Associates, Inc.
**J. A. CAMPBELL CO.** ★
Agency—The McCarty Co.
**CHAPMAN VALVE MFG. CO., THE** Inside Back Cover
Agency—Sutherland-Abbott
**CHESAPEAKE & OHIO RAILROAD.** ★
Agency—Robert Conahay, Inc.
**CLEAVER BROOKS CO. (BOILER DIV.)** ★
Agency—Klau-Van Pietersom-Dunlap, Inc.
**CLEVELAND FUEL EQUIPMENT CO.** ★
Agency—G. M. Basford Co.
**COCHRANE CORPORATION.** ★
Agency—Hening & Co., Inc.
**COMBUSTION ENGINEERING, INC.** 10–11
Agency—G. M. Basford Company
**CONDENSER SERVICE AND ENGINEERING.** 128
Agency—Diener & Dorskind, Inc.
**COPES-VULCAN DIV., BLAW-KNOX CO.** 51
Agency—Ketchum, MacLeod & Grove, Inc.
**CRANE CO.** 47
Agency—The Buchen Company
**CRANE PACKING CO.** 139
Agency—Symonds, MacKenzie & Co., Inc.

**DAVIS ENGINEERING CORPORATION.** ★
Agency—Thomas & Delehanty, Inc.
**DEARBORN CHEMICAL CO.** 55
Agency—The Buchen Co.
**DE LAVAL SEPARATOR CO., THE** 5
Agency—Donahue & Coe, Inc.
**DE LAVAL STEAM TURBINE CO.** 57
Agency—Michel-Cather, Inc.
**DETROIT STOKER COMPANY.** ★
Agency—Witte & Burden
**DIAMOND POWER SPECIALTY CORP.** 107
Agency—Witte & Burden
**DODGE MANUFACTURING CO.** 120, 121
Agency—Lampert, Fox, Prell & Dolk Inc.
**DOWELL INCORPORATED** 27
Agency—MacManus, John & Adams, Inc.

**ECONOMY FUSE & MFG. CO.** ★
Agency—Van Auken, Ragland & Stevens
**EDISON, THOMAS A.** ★
Agency—Gaynor, Colman Prentis & Varkey, Inc.
**EDWARD VALVES, INC.** 21, 23
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
**ELECTRICAL ENGINEERS EQUIPMENT CO.** 108
Agency—Hollander & Weghorn
**ELLIOTT CO.** ★
Agency—Peterson & Kempner, Inc.
**ELLISON DRAFT GAGE CO.** ★
Agency—Tri-State Advertising Co., Inc.
**ENGINEER CO., THE** 130
Agency—Michel-Cather, Inc.
**ERIE CITY IRON WORKS.** 14–15
Agency—Davies and McKinney
**ERNST WATER COLUMN & GAGE CO.** 135
**EVERLASTING VALVE CO.** ★
Agency—Michel-Cather, Inc.

**FLEXONICS CORP.** ★
Agency—Russell T. Gray, Inc.
**FOSTER CO., BENJAMIN.** 126
Agency—Elmer P. Cook Associates
**FOSTER WHEELER CORP.** 49, 60–61
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
**FULLER CO.** ★
Agency—O. S. Tyson & Co., Inc.

**GARLOCK PACKING CO., THE** ★
Agency—Hutchins Advertising Company, Inc.
**GENERAL ELECTRIC CO.** ★
Agency—G. M. Basford Co.
**GENERAL FILTER CO.** ★
Agency—Mike Fadell Advertising Agency
**GOODALL RUBBER CO.** ★
Agency—George C. Taylor Advertising
**GRAVER WATER CONDITIONING.** 129
Agency—Trade Method Advertising

**HAGAN CORPORATION.** ★
Agency—Ketchum, MacLeod & Grove, Inc.
**HALL LABORATORIES, INC.** 119
Agency—Ketchum, MacLeod & Grove, Inc.
**HENSZEY COMPANY.** 135
Agency—Keck Advertising Agency
**HUYETTE CO., INC. PAUL B.** ★

**ILLINOIS WATER TREATMENT CO.** 133
Agency—Cummings, Brand & McPherson
**INFILCO INC.** 140
Agency—Willard G. Gregory & Co.
**INSTROF, INC.** ★
Agency—R. E. Lovekin Corp.
**INTERNATIONAL NICKEL COMPANY, INC., THE** 53
Agency—Marschalk & Pratt Co. Division of McCann-Erickson, Inc.

**JERGUSON GAGE & VALVE.** ★
Agency—Roy Elliott Co.
**JOHNS-MANVILLE.** 35
Agency—J. Walter Thompson Company
**JOHNSON-MARCH CORP.** 112
Agency—Beaumont, Heller & Sperling, Inc.

**E. KELLER CO.** 111
Agency—Charles F. Williams Advertising
**KIRK & BLUM MFG. CO.** 54
Agency—The S. C. Baer Co.
**KOR CORPORATION.** ★
**KULJIAN CORP.** ★
Agency—The Roland G. E. Ullman Org.

**LACLEDE CHRISTY CO., DIVISION H. K. PORTER CO., INC.** ★
Agency—Arthur R. MacDonald, Inc.
**LADISH CO.** ★
Agency—The Cramer-Krasselt Co.
**LEFAX PUBLISHERS.** ★
Agency—H. Lesseraux
**LESLIE CO.** ★
Agency—Reid, Decker & Stocki, Inc.

**MADDEN CORP., THE** 136
Agency—Kreicker & Molane, Inc.
**MANNING, MAXWELL & MOORE, INC.** 125
Agency—Fuller & Smith & Ross, Inc.
**MARLEY CO., THE** 28
Agency—Valentine-Radford Advertising
**MERIAM INSTRUMENT CO., THE** ★
Agency—Thomas R. Sundheim
**MILTON ROY CO.** 31
Agency—The Aitken-Kynett Co.
**MORTON SALT CO.** 58
Agency—Needham, Louis & Brorby, Inc.
**MUNDET CORK CORP., INSULATION DIV.** ★
Agency—J. C. Bull, Inc.

**NAGLE PUMPS, INC.** 130
Agency—Tri-State Advertising Co., Inc.
**ATIONAL AIROIL BURNER COMPANY, INC.** ★
Agency—R. E. Lovekin Corp.
**NATIONAL ALUMINATE CORPORATION.** 24
Agency—Armstrong Advertising Agency
**NATIONAL COAL ASSOCIATION.** 109
Agency—Vansant, Dugdale & Co.
**NATIONAL VALVE & MFG. CO.** ★
Agency—Bond & Starr, Inc.
**NEW ENGLAND CARBIDE TOOL CO.** ★
Agency—Callaway Association
**NIAGARA BLOWER COMPANY.** ★
Agency—The Moss-Chase Company
**NORDEN-KETAY CORP.** ★
Agency—Hicks & Greist Inc.

**OHIO INJECTOR CO.** Inside Front Cover
Agency—Fuller & Smith & Ross, Inc.
**OLD BEN COAL CO.** 62
Agency—W. S. Kirkland Advertising

**PACIFIC PUMPS, INC.** ★
Agency—The McCarty Co.
**PEABODY ENG. CORP.** ★
Agency—Richard LaFond Adv. Inc.
**PEERLESS PUMPS DIV. FOOD MACHINERY & CHEMICAL CORP.** ★
Agency—The McCarty Co.
**PERMUTIT CO., THE** ★
Agency—Cunningham & Walsh, Inc.
**PHILADELPHIA PUMP & MACHINERY CO.** 45
Agency—The Michener Co.
**PITTSBURGH PIPING & EQUIPMENT CO.** 1
Agency—W. S. Hill Co.
**POWELL VALVES.** 42
Agency—The Ralph M. Jones Co.
**PREFERRED UTILITIES MFG. CORP.** ★
Agency—Spooner & Kriegel

**QUAKER RUBBER CO2P. DIVISION OF H. K. PORTER CO., INC. OF PITTSBURGH.** ★
Agency—Fox & MacKenzie Advertising

**RAYBESTOS-MANHATTAN, INC.** 114
Agency—Gray & Rogers
**REFRACTORY & INSULATION CORP.** 134
Agency—Spooner & Kriegel
**RELIANCE GAUGE COLUMN COMPANY.** 118
Agency—Carr Liggett Advertising, Inc.
**REPUBLIC FLOW METERS CO.** 38–39
Agency—Stoetzel & Associates, Inc.
**REVERE COPPER AND BRASS, INC.** 103
Agency—St. Georges & Keys, Inc.
**RIC-WIL INC.** ★
Agency—Ritchie & Sattler, Inc.
**RILEY STOKER CORPORATION.** 18–19
Agency—The Davis Press, Inc.
**ROCKWELL CO., W. S.** 132
Agency—Spooner & Kriegel
**ROSS HEAT EXCHANGER DIVISION.** ★
Agency—Harold Warner Co.
**ROTO DIV. OF ELLIOTT CO.** 116
Agency—Jos. Vogel & Co.
**R-P & V VALVE DIVISION, AMERICAN CHAIN & CABLE CO., INC.** 52
Agency—Reincke, Meyer & Finn, Inc.

**SARCO COMPANY, INC.** 132
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
**SCHUTTE & KOERTING CO.** 139
Agency—Richardson, Thomas & Bushman, Inc.
**M. SETLOW & SON, INC.** ★
Agency—J. W. Shepard Co.
**SIMS PUMP VALVE CO., INC.** 135
**SINCLAIR REFINING CO.** 41
Agency—Morey, Humm, & Warwick, Inc.
**SOUTHERN COAL CO., INC.** ★
Agency—Hitchcock & Becker Advertising
**SPENCE ENGINEERING CO.** 59
Agency—Michel-Cather, Inc.
**STANDARD OIL CO. (INDIANA).** ★
Agency—D'Arcy Advertising Co.
**STEPHENS-ADAMSON MFG. CO.** 117
Agency—Connor Associates, Inc.
**STONE & WEBSTER ENGINEERING CO.** 33
Agency—Harold Cabot & Co., Inc.
**STRUTHERS WELLS CORP.** 56
Agency—Downing Industrial Advertising Inc.
**SUPERIOR COMBUSTION INDUSTRIES, INC.** 122
Agency—Charles H. Davis

**TAYLOR & CO., W. A.** ★
Agency—Emery Advertising Corporation
**THE TERRY STEAM TURBINE CO.** 113
Agency—Gassaway Advertising Agency
**TEXAS CO., THE** Back Cover
Agency—Erwin, Wasey & Company Inc.

**ULLMAN PRODUCTS CORP.** ★
Agency—Shelvo, Inc.
**UNION IRON WORKS.** 105
Agency—Harold Warner Co.
**U. S. ELECTRICAL MOTORS, INC.** ★
Agency—The McCarty Co.
**UNIVERSAL ATLAS CEMENT CO.** 34
Agency—Batten, Barton, Durstine & Osborn, Inc.

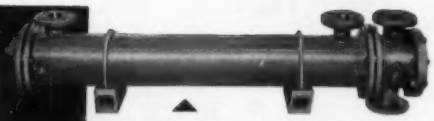
**VAN DER HORST CORP.** ★
**VOGT MACHINE CO., HENRY.** 127
Agency—Farson, Huff & Northlick

**W-S FITTINGS DIVISION, H. K. PORTER CO., INC.** 30
Agency—W. L. Towne Advertising
**WESTERN CHEMICAL COMPANY.** 32
Agency—Carter Advertising Agency, Inc.
**WESTERN PRECIPITATION CORP.** ★
Agency—Dozier-Eastman & Co.
**WILLIAMS GAUGE CO.** ★
Agency—Downing Industrial Advertising, Inc.
**WILSON, INC., THOMAS C.** 139
Agency—Michel-Cather, Inc.
**WORTHINGTON CORPORATION.** ★
Agency—Needham, Louis & Broby, Inc.

**YARNALL-WARING COMPANY.** 8–9, 64
Agency—The Michener Co.


Firms whose advertising is not in this issue but is appearing in other issues is marked with an ★

make your headquarters for STANDARD or SPECIAL HEAT TRANSFER UNITS



**STANDARD** SK Type "BD" Heat Exchanger, two-pass design for service in petroleum, power, chemical processing, and other industries. Also made in single-pass design.

**SPECIAL** SK Radiafin Air Cooler, one of two large coolers designed and manufactured for a special project. SK welcomes inquiries for special units—willingly offers experienced assistance.

**Get Full Details. Write for Bulletin HT-1.**

Schutte and Koerting COMPANY
MANUFACTURING ENGINEERS

2221 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

| Jet Apparatus: Ask for Condensed Bulletin J-1. | Rotameters & Flow Indicators: Ask for Condensed Bulletin 18-RA. | Valves: Ask for Condensed Bulletin V-1. | Heat Transfer Apparatus: Ask for Condensed Bulletin HT-1. | Gear Pumps: Ask for Bulletin 17-A. |
|---|---|---|---|---|

**For more data circle 588 on Post Card**

FOR HOT BOLTS USE Thred-Gard Anti-Seize Compound

*Prevents Seizing and Galling of Threaded Surfaces to 1200°F.*

FLANGED PIPE CONNECTIONS

**Power and Utility Service:** boiler manhole, handhold and face plate studs . . . cylinder head and exhaust manifold studs . . . flange bolts on high temperature pumps, valves and steam lines.

CYLINDER HEADS

**Refinery and Chemical Service:** flange bolts on pipe connections, autoclaves, reactors, kettles, pumps and valves . . . studs on "cat" crackers, heat exchangers, suction heaters, coolers and condensers.

HANDHOLD AND FACE PLATES

**Steel Mill, Forge and Foundry Service:** soaking pit or ingot stripper crane assemblies . . . steel studs in magnesium and aluminum dies and forging dies . . . studs on furnaces and cooking ovens.

Available in ½ pint, pint and quart cans. Order a trial can today!

*Send for free sample and literature.*

CRANE PACKING COMPANY
6429 OAKTON STREET, MORTON GROVE, ILL. (Chicago Suburb)
*In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*
OFFICES IN ALL PRINCIPAL CITIES

**For more data circle 589 on Post Card**

PLAY SAFE!...

Roll tubes the WILSON Way

Rolling tubes in high pressure boilers, superheaters, economizers, marine steam generators and other heat exchange equipment is simple *and* safe with Wilson Tube Expanders.

Wilson Tube Expanders offer smooth, efficient rolling action, which insures firm seating of the tube, provides perfectly rolled joints, reduces time-wasting re-rolling and re-inspection. For example, Wilson Model 38 Tube Expander, shown here, is a popular tool which rolls and flares in a single operation. It is available for tubes from 1" OD to 4½" OD with various roll lengths for tube sheets ½" and up in thickness.

FREE Wilson Catalogs

Write for new Wilson Tube Cleaner Catalog 77 and comprehensive Tube Expander Catalog. ➔

Representatives in all principal cities
THOMAS C. WILSON, INC.
21-11 44th AVENUE, LONG ISLAND CITY 1, N. Y.
CABLE ADDRESS: "TUBECLEAN" NEW YORK

WILSON TW846
TUBE CLEANERS • TUBE EXPANDERS

**For more data circle 590 on Post Card**

# NEW JONES & LAUGHLIN WATER-TREATMENT PLANT *with* AUTOMATION *and* EQUIPMENT *by* INFILCO

## *cuts hardness from 268 to 2 p.p.m. —greatly reduces labor costs*

The Monongahela River is the source of raw water for steam generating plants of Jones & Laughlin Steel Corporation. Total hardness ranges up to 268 p.p.m.—clarity and degree of acidity fluctuate widely.

Using a cold-process, lime-batch plant, hardness could only be reduced to about 1.5 grains per gallon, or 26 parts per million.

INFILCO equipment, including C.-A.-P. SYSTEM® instruments was chosen for greater efficiency and automatic operation. The new plant produces water averaging about 0.1 grain per gallon —2 p.p.m.—hardness. It has cut labor costs more than 50% and made better service possible. And the end result — steam production — is more efficient and economical, too.

This is another example of INFILCO leadership in this field — further proof that

***Infilco knows how***

to help you solve your water-treatment problems. For complete information about this interesting installation, write today for Reprint No. 70-EP-11.

**INFILCO INC.**

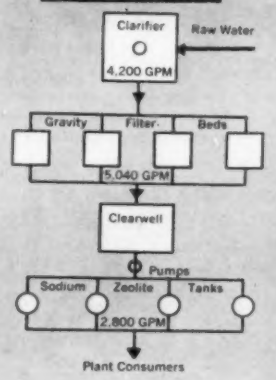
**General offices, Tucson, Arizona**

*The* ***one*** *company offering equipment for* ***all*** *types of water and waste treatment*

5611

FIELD OFFICES THROUGHOUT THE UNITED STATES AND FOREIGN COUNTRIES

## INFILCO EQUIPMENT automatically

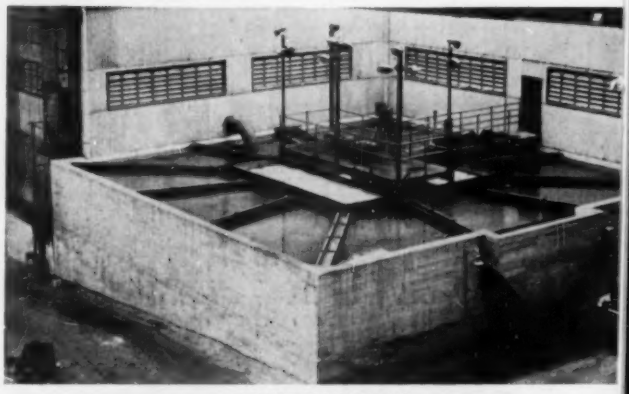



**...MEASURES flow, maintains constant water level, keeps amounts of chemical proportional, removes sludge.**

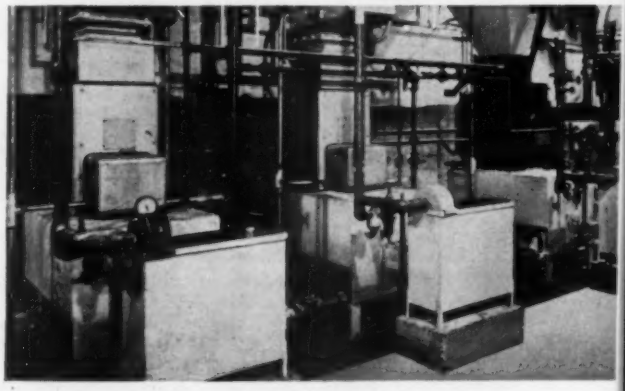
**...EQUALIZES water passage by flow control and loss-of-head control, maintains same flow rate, controls backwash.**

**...PUMPS water to softening units and then meters it to five 175,000-lb./hr. boilers for steam generation.**

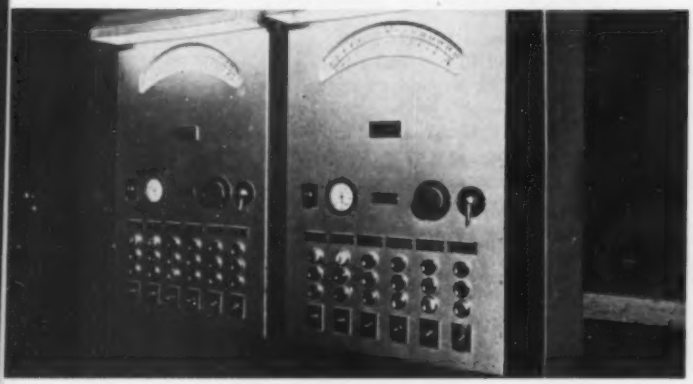
MAIN PLANT COMPONENTS AND AUTOMATION



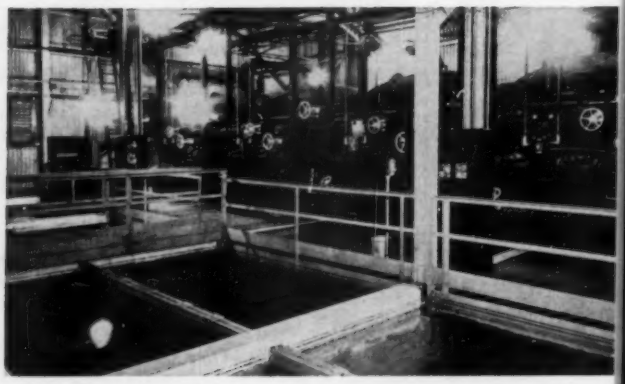
CLARIFICATION BASIN



CHEMICAL FEEDERS



FILTER BED CONTROL PANELS



ELECTRICALLY CONTROLLED SODIUM-ZEOLITE SOFTENING UNITS

**For more data circle 391 on Post Card**

# NO FRILLS..

## All Business

*for valves, floorstands and sluice gates*

## CHAPMAN MOTOR UNITS

Just look at them . . . inside as well as out. You'll find that Chapman Motor Units are not only rugged in construction, *they're simple in design.* In fact, a Chapman Motor Unit has approximately *half as many parts* as any other unit.

This simplicity means better, easier operation and lower maintenance costs. It means longer life with fewer repairs.

With Chapman Motor Units your valves seat tight . . . but never too tight. Micrometer adjustment on limit switch insures exact tightness presetting. Drift is eliminated. Lash is slashed. Complete operation by low speed motors is always smooth, accurate and trouble free.

Use them in any position. Quiet, rugged stub-tooth gears require no grease or oil. Use them under the most adverse conditions. They're weatherproof, steamtight, dependable.

Installation is quick and easy. Chapman Motor Units and Floorstands are wired and ready to tie in with your leads. Just hitch them up. You're in business.

Get the whole interesting story in our newest catalog 51. Write for it, your copy, now.

**The CHAPMAN VALVE Mfg. Co.**
**INDIAN ORCHARD, MASS.**

**For more data circle 592 on Post Card**

# Keep system clean... no sludge, no rust, no foam

YOU CAN best assure clean turbine systems by lubricating with *Texaco Regal Oil R&O* – the oil especially refined and processed to *prevent* sludge, rust and foam.

*Texaco Regal Oil R&O* is premium quality oil. It has notably high resistance to oxidation and an exceptionally long service life. It keeps bearing temperatures normal and governor response instantaneous.

There is a complete line of *Texaco Regal Oils R&O* meeting the strict requirements of all leading turbine builders for all types and sizes of turbines.

Let a Texaco Lubrication Engineer help you step up efficiency of all your power plant equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

**TEXACO Regal Oils R&O**

**FOR ALL TURBINES**

**TUNE IN... TEXACO STAR THEATER starring JIMMY DURANTE on television... Saturday nights, NBC.**

For more data circle 593 on Post Card